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THE JOURNAL

OF

THE LINNEAN SOCIETY.

Notes on the Genera of *Taxaceæ* and *Coniferæ*. By Maxwell T. Masters, M.D., F.R.S., F.L.S., Corresponding Member of the Institute of France.

[Read 15th December, 1892.]

The following observations are the outcome of a comparative examination of the morphological characters of all the genera of *Taxaceæ* and *Coniferæ* so far as I have been able to accomplish it. In most cases living plants have been examined, and in all instances the available museum and herbarium specimens have been studied and the literature relating to them referred to. It is not necessary to state the sources whence I have derived my information, as they are given in my paper on the Comparative Morphology of the Order, published in the Journal of this Society, Botany, vol. xxvii., and again in a List of Conifers and Taxads in cultivation in Great Britain, prepared for the Conifer Congress, and published in vol. xiv. of the Journal of the Royal Horticultural Society in October 1892. Constant reference has also been made to the schemes of arrangement proposed by the older writers, and in more recent times by Eichler, Van Tieghem, and others. In the main, however, I have followed the lines laid down by Bentham, in Bentham and Hooker's 'Genera Plantarum,' iii. p. 420 *et seq.* (1880). In some cases I have felt constrained to deviate from the arrangement there made, and to propose others which, according to my judgment, are more in harmony with ascertained facts or with more recently acquired information. Incidentally a few indications of the structural peculiarities of certain parts, which may be available for purposes of distinction, are given, but any attempt to deal fully with comparative histology would be beyond the scope of the present communication. The writings of Bertrand and of Van Tieghem may be specially pointed out as containing most valuable information on this head. Embryological researches also are of the foremost importance from a classificatory point of view, but they demand for their prosecution more time and skill than are at the command of the writer. It is, however, to systematic and comparative investigation in these two departments, minute anatomy and embryology, that we must now look for future progress, but that progress will be retarded until the rigidly comparative and systematic methods by means of which the framework of the Natural System has been pieced together shall be carried out also in histology and embryology. And this remark applies as strongly to the methods in which these observations are recorded and published as to the observations themselves. Classifications founded on leaf-structure, on the distribution of the resin-canals and fibro-vascular bundles, or on the structure of the wood even, without reference to all other evidence, are necessarily as "artificial" as any other truncated schemes.

For details concerning the structure of fossil species the reader will naturally refer to the publications of Williamson, Carruthers, and others. For the indications as to geological distribution I am chiefly indebted to Renault and Starkie Gardner.

TAXACEÆ,

Lindley, Vegetable Kingdom, ed. 3 (1853), p. 230.

Arbores vel frutices. Rami plerumque homomorphi raro dimorphi. Folia persistentia raro decidua. Flores masculi amentiformes. Squamæ fructiferæ, ut videtur, simplices, liberæ, membranaceæ seu demum carnosæ nunquam lignosæ. Ovula erecta v. pendula, e squamâ emergentes, arillata vel raro arillo destituta. Testa sicca seu demum carnosa nunquam alata.

Tribus I. SALISBURINEÆ.

Flores dioici; testa carnosa arillo genuino deficiente vel imperfecte evoluto.

Ramuli dimorphi. Folia decidua.
    Flores masculi umbellati.............. 1. GINKGO.
Ramuli homomorphi. Folia persistentia.
    Flores masculi capitati .... 2. CEPHALOTAXUS.
    Flores masculi spicati................. 3. TORREYA.

Tribus II. TAXINEÆ, *vide* p. 6.

GINKGO.

The earliest mention of this genus is by Kaempfer in 1712, and it was adopted by Linnæus, in his 'Mantissa,' ii. 313, in 1771. It is remarkable for its shoots, some of which are elongated, others contracted, its fan-shaped, many-ribbed, deciduous leaves, and diœcious flowers. The male flowers are stipitate, catkin-like, arranged in umbels on the ends of branches, having short, contracted, or undeveloped internodes and intermixed with leaves. Anther-lobes two, pendulous, divergent, connective prolonged into a knob. Pollen not seen. The female flowers are borne in pairs on the sides of slender stalks, each flower consisting of a single erect ovule destitute of bract or scale, but arising from a cup-shaped dilatation of the axis without any true arillus. The testa of the seed, however, eventually becomes succulent and drupe-like, while the inner coat becomes hard and woody, as in *Cycas*. The seed in the interior is covered with a brown membrane, the lower half of which is adherent to the shell, so that, on removing the latter, the lower part of the perisperm is bared. A similar appearance is presented in the seeds of *Cycas*. As in the case of *Torreya* and *Cephalotaxus*, the structure of the ripe seed has a close resemblance to that of *Cycas*, the nucellus having a well-marked pollen-chamber. According to Van Tieghem, Bull. Soc. Bot. France (1891), there are in the axis of the pith two resin-canals. The same author asserts that fertilization only takes place in the ripe seed after its fall in autumn, and that the embryo is only developed in the following winter.

The cotyledons, in germination, remain within the seed, their stalks protruding in an arched manner, the cylindrical tigellum or hypocotyl descending vertically into the ground, while the plumule ascends, bearing several scattered rudimentary leaves, arranged on the $\frac{1}{3}$ plan before the perfect leaves are formed. Clustered raphides occur in the leaves—a most unusual occurrence in Conifers.

In the anatomical structure of the root the most striking feature is the abundance of callus-thickenings in the angles of the cells of the endoderm. There is a single fibro-vascular bundle.

The leaves have no true palisade-cells, the two fibro-vascular bundles of the petiole branch into several which traverse the lamina; each is ovoid in section, with xylem resting on the phloem. Wedge-shaped masses of sclerous tissue occur here and there beneath the epiderm, but no true exoderm.

The genus is now represented by a single Chinese and Japanese species, but was once so widely distributed through the colder and temperate parts of the northern hemisphere, that Prof. Heer enumerated no fewer than sixty species in the Secondary and Tertiary strata of various parts of the globe. It seems probable that most of these are mere variations from a single species.

CEPHALOTAXUS.

A genus first published in 1840 by Siebold and Zuccarini in their 'Flora Japonica.' The species are shrubs or trees with spirally arranged leaves, which, on the lateral branches, become twisted into an apparently two-ranked arrangement. The flowers are diœcious, in stalked axillary heads, each flower subtended by a bract. Male flowers numerous, clustered, capitate. Anthers 3-lobed, pendulous from the apex of the filament. Connective prolonged. The female flowers are bracteate and arranged in terminal spikes or heads. The base of each bract becomes more or less fleshy, forming a cup-shaped cavity around a short shoot, which bears one or two erect ovules destitute of aril. The testa of the seed, however, becomes succulent, the inner lining bony, so that the ripe seed resembles a drupe, and is similar to the seed of *Cycas* or of *Ginkgo*, as described under the latter genus.

In germination the seedling plant shows a thick fusiform tigellum or hypocotyl, two long linear cotyledons, from between which the plumule emerges before the cotyledons are disengaged from the seed-coats, as in *Ginkgo*, but the primary leaves are opposite and verticillate.

The leaf-section (*Cephalotaxus drupacea*) shows the midrib prominent on the upper surface, a thick epiderm, no exoderm, and a single layer of palisade-cells above the mesophyll. In the centre is the fibro-vascular bundle, in section, of an elliptical shape, with ill-defined endoderm. Immediately beneath the phloem is a single central resin-canal, between which and the lower epiderm two or three rows of cells intervene. The stomata are abundant on the lower surface; they are of the usual reniform shape, and are arranged in linear series. Van Tieghem notes the presence of a resin-canal in the centre of the pith, a character which separates it from all Conifers except its near ally *Ginkgo*, which has two in the same situation (Bull. Soc. Bot. France, 1891, April 24).

By Bentham and Hooker this genus is placed among the *Taxodineæ*. It is, however, evident that its nearest affinity is with *Ginkgo* and *Torreya*, and that it has relatively little in common with *Taxodineæ*.

The species are natives of China and Japan, extending into Khasia.

TORREYA.

A genus established by Arnott in 1838, in Ann. Nat. Hist. ser. 1, vol. i. p. 130. The leaves are spirally disposed, the flowers diœcious. The male flowers are axillary, spike-like, surrounded at the base by imbricate scales; each stamen has a filament which expands at its upper portion into 2–4 longitudinally dehiscing pollen-sacs; connective slightly prolonged. The female flowers are solitary, axillary, with imbricating, rather fleshy scales at the base. The erect ovule is gradually invested from below upwards by a fleshy aril, which becomes confluent with the succulent testa, so that in the ripe seed it is no longer distinguishable. Seed drupaceous. Embryo pendulous in floury or ruminate perisperm. The leaf-structure is almost identical with that of *Cephalotaxus*, but branched sclerous cells occur in the mesophyll, which confer strength in the absence of the exoderm. The fibro-vascular bundle has a semilunar form, and is surrounded by an endoderm with thick-walled cells. The solitary central resin-canal of the leaves resembles that of the species of *Tsuga*.

The species are natives of California, South-eastern United States, Japan, and China. In a fossil condition they are stated to occur in beds of the Miocene period.

Tribus II. TAXINEÆ.

Flores monoici vel dioici; testa sicca arillata vel exarillata.

Ovula semper vel ad postremum erecta.	Subtribus I. TAXEÆ.
Ovula exarillata	4. PHEROSPHÆRA.
Ovula arillata.	
Flores feminei perulati.	
Ramuli foliaceo-dilatati	5. PHYLLOCLADUS.
Ramuli teretes	6. TAXUS.
Flores feminei eperulati	7. DACRYDIUM.
Ovula semper vel ad postremum inversa; testa sicca arillo carnoso circumdata.	Subtribus II. PODOCARPEÆ.
Pedunculus bracteæque demum carnosæ concrescentes	8. PODOCARPUS.
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Fructus dense aggregati.	
Folia specie disticha linearia; flores monoici	10. SAXEGOTHÆA.
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PHEROSPHÆRA.

A genus nearly allied to *Dacrydium*, established by Archer and Hooker, in Hooker's 'Kew Journal of Botany,' in 1850. The leaves are decussate and spirally imbricate, the flowers diœcious; male flowers terminal, anthers subsessile, spirally arranged; connective with a scale-like projection; pollen subglobose, somewhat trigonous, or oblong curved, with opaque spaces at the ends or angles. In the female flowers loosely imbricate bracts are alone visible, without any trace of scale externally, but no opportunity of examining the microscopical structure has presented itself. The solitary ovule, at first inverted, proceeds apparently directly from the base of the bract, which does not become succulent. The seed, which is ultimately erect, is not surrounded by any aril. By Eichler this genus is included under *Dacrydium*, but the aggregation of the female flowers, the simplicity of their structure, and the absence of an aril, seem to warrant keeping it distinct.

The plant is a native of Tasmania and of the Blue Mountains of Victoria (see Hooker's 'Icones Plantarum,' t. 1383).

PHYLLOCLADUS.

L. C. Richard, in 1826, proposed the establishment of this genus, which has been generally adopted. The species are remarkable for their flattened, entire, or lobed phylloclades. The leaves, from whose axils these organs spring, are small and scale-like. The flowers are monœcious or diœcious, the males stalked, clustered or solitary, catkin-like, each arising from the axil of a leafy bract. The anthers are imbricate, two-celled, dehiscing lengthwise at the sides; the connective is prolonged into an acute crest. The female flowers are few, or aggregated in close heads along the edges of the phylloclade, each protected by one or more bracts which eventually become fleshy. Ovule solitary, inverted, but subsequently erect, surrounded at the base by a tubular aril which becomes fleshy, but which never entirely conceals the erect seed.

The two cotyledons are linear, and are followed by primordial leaves of similar form, which soon give place to scale-like leaves. The leaves at the base of the male flowers are broader and strap-like. The leaves have small resin-canals close to the exoderm on the lower surface of the leaf (*P. alpinus*), and a single central vascular bundle. In the phylloclade of *P. alpinus* beneath the upper epiderm is a layer of perfect parenchyma, traversed by a central and by numerous lateral fibro-vascular bundles.

The species are natives of Tasmania, New Zealand, and the mountains of Borneo; and some species are known to have existed in Nebraska and in Spitzbergen in the Cretaceous epoch (*Renault*).

TAXUS.

A classical name adopted by Tournefort (1700) and taken up by Linnæus (1737) and by all subsequent authors. The leaves are spirally disposed, but so twisted on the side shoots as to appear distichous. On the leader shoots, and in the fastigiate forms, the leaves are not twisted, so that their spiral arrangement is always apparent. The flowers are usually diœcious, rarely monœcious. The male flowers are stipitate, the stipes surrounded at the base by imbricating, perular scales, and bearing above a spike of anthers with 4–6 lobes radiating from the under surface of a peltate connective, recalling the appearance of the spore-cases of *Equisetum*. The anther-lobes open lengthwise and liberate globose microspores. The female flowers are solitary, terminal, and surrounded at the base by numerous imbricate, marcescent bracts. Ovule erect, surrounded by an aril which ultimately forms a fleshy cup in which the ripe seed is nearly enclosed. The two cotyledons are linear, obtuse, leafy, and are succeeded by smaller leaves of the same form.

The leaves of *T. baccata* have the midrib prominent on the upper surface and the margins are recurved. The upper epiderm is smooth, the lower papular. There is no hypoderm, but well-marked palisade is present. The vascular bundle is single, elliptic in outline, the pericycle being surrounded by an ill-defined endoderm. There are no resin-canals. The root-fibrils show a loose epiderm with root-hairs, a thick cellular cortex, and a single cylindrical fibro-vascular bundle in which masses of xylem alternate with similar masses of phloem. The pericycle is surrounded by endoderm-cells, the angles of which are much thickened by callus.

Bertrand (Ann. Sc. Nat. sér. V. xx. 1874, p. 53) points out the anatomical differences between the several species, especially in the nature of the epiderm and the disposition of the stomates.

The species are natives of the northern hemisphere in both continents, while fossil remains in various countries attest the existence of the genus since Miocene times.

DACRYDIUM.

A name taken up by Lambert (1803) from Solander [*]. The species have heterotaxic and heteromorphic leaves. The flowers are diœcious, the males at the ends of the branches; anthers sessile, spirally imbricate, two-lobed, dehiscing laterally, and with a prolonged spur-like connective. Pollen-grains oval or oblong. Female flowers solitary, terminal. The uppermost bracts are thickened; one of them bears an ovule at first inverted or placed horizontally, but ultimately erect and surrounded at the base by a tubular fleshy aril. The cotyledons are two in number and leafy.

The genus is well illustrated in Sir Joseph Hooker's 'Flora of Tasmania,' and in T. Kirk's 'Forest Flora of New Zealand.'

Lepidothamnus of Philippi is referable to this genus.

The species are natives of the Malay Peninsula, Borneo, New Zealand, Tasmania, New Caledonia, and Chile.

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[*] Solander in G. Forster, Plant. Esculent. (1786).

PODOCARPUS.

A genus established by L'Héritier in 1788. The leaves vary in attachment and in form. The flowers are monœcious or diœcious; the males solitary on the ends of short axillary shoots, catkin-like, stipitate, stipes surrounded by perular scales. Anthers spirally disposed, sessile, two-lobed, dehiscing longitudinally; connective prolonged into a short point. Pollen-grains with two air-sacs. Female flowers 1 or 2, lateral, stalked, surrounded at the base by a few bracts, which, together with the raphe of the ovule, the peduncle, and the outer coat of the seed, become fleshy. Ovule solitary, anatropous. Cotyledons two, leafy.

The leaf-structure has been studied by Bertrand in certain species. In *P. Manni* and *P. chilensis* I find a thick exodermal layer (especially so in the first-named), palisade-cells, areolar cells, surrounding an undivided fibro-vascular bundle, beneath which is a solitary resin-canal.

The species are natives of tropical and subtropical regions of both hemispheres, and occur also in Tasmania. Traces of their existence occur in the Miocene beds of Central Europe.

STACHYCARPUS.

Endlicher proposed the name *Stachycarpus* for a section of the genus *Podocarpus*, distinguished from the remainder of the genus by the peduncle not becoming fleshy, " receptaculum carnosum nullum." In this section he included *P. falcata, taxifolia, andina, ferruginea*, and *spicata*. Bentham and Hooker, *l. c.* p. 435, include only *P. spicata* and *P. andina*, Poeppig, in this group. The genus *Prumnopitys* of Philippi (Linnæa, xxx. 731) is founded on the latter species.

Quite recently Van Tieghem has gone a step further and proposed the establishment of a new genus * for species wherein the fruits are on a loose spike, the axis of which does not become fleshy. The distinctions observed in the reproductive organs are correlated with other distinctions in minute structure. Thus, in *Stachycarpus* there are, according to Van Tieghem, resin-canals in the pericycle of the root outside the phloem of the vascular bundle, as in *Araucaria* and in *Dammara*, but not in other *Taxineæ*, nor in *Cupressineæ*, nor in *Abietineæ* proper.

The species are natives of Chile, Australia, and New Zealand.

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* Van Tieghem, " *Stachycarpus*, genre nouveau de la famille des Conifères," Bull. Soc. Bot. France, 1891, p. 163.

SAXEGOTHÆA.

This interesting Chilian genus was founded in 1852 by Lindley, who says of it, "The genus *Saxegothæa* forms a transition of a most remarkable kind, from Conifers to Taxads. Sir William Hooker regarded it as a Podocarp with flowers in a cone. It is in reality a genus with the male flowers of a Podocarp, the female flowers of a Dammara (*Agathis*), the fruit of a Juniper, the seed of a *Dacrydium*, and the habit of a Yew" ('Vegetable Kingdom,' p. 229). The foliage and habit are, indeed, those of a Yew, the male flowers are axillary, stalked, catkin-like; the anthers arranged spirally, each opening longitudinally, and destitute of a crest. In the original illustrations, however, such an appendage is distinctly represented. The pollen-cells are globose. The leaves on the cone-bearing branches pass gradually into spirally arranged, but distant scales, which, in their turn, graduate into thick, ovate-lanceolate, loosely and spirally imbricate bracts, simple externally, but each provided near the base with a cavity from the upper end of which hangs a single free ovule. The bracts ultimately become fleshy and consolidated into a more or less pulpy head or spike. In floral structure the genus approaches the *Araucarineæ*, but the habit is more like that of *Taxus*. Bertrand (in Ann. Sc. Nat. sér. V. xx. 1874, p. 69) describes the structure of the leaf as very similar to that of *Podocarpus*.

MICROCACHRYS.

Sir Joseph Hooker was the founder of this genus in 1845. It is represented by a Tasmanian shrub with small decussate leaves, which pass gradually at the ends of some of the branches into stamens. The flowers are diœcious, the males in terminal spikes; anthers stipitulate, two-lobed, dehiscing transversely, and provided with an incurved, scale-like connective. Pollen-grains 3-cornered, or somewhat globose. Female flowers terminal; bracts spirally imbricate, given off at right angles to the axis, apparently simple, bearing an inverted ovule, and ultimately becoming succulent, and as it lengthens carrying the ovule with it, so that the latter becomes placed horizontally. A fleshy, tubular aril grows from below upwards over the greater part of the woody testa of the seed, leaving the apex exposed. Seed 3-sided.

It differs from *Podocarpus* mainly in the form of the pollen-grains, the aggregated fruits, and the woody axis of the spike. From *Dacrydium* it differs in the aggregated female flowers and in the succulent bract.

CONIFERÆ,

Linn. Phil. Bot. p. 28 (plurimum), =

PINACEÆ, *Lindley, Vegetable Kingdom*, p. 226.

Arbores seu frutices resiniferæ. Flores masculi amentiformes, antheris seu microsporangiis numerosissimis. Flores feminei strobiliformes. Squamæ fructiferæ duplices e bracteâ et e squamâ seu sporophyllo lignoso rarius carnoso constantes. Bracteæ nisi ad basin liberæ vel plus minus cum squamâ concrescentes. Ovula (seu macrosporangia) erecta vel pendula pauca vel plura. Semina alata vel exalata arillo omnino destituta.

Tribus I. CUPRESSINEÆ.

Folia verticillata seu decussata. Stamina decussata vel ternatim verticillata; antheræ loculi globosi. Strobili maturi squamæ oppositæ vel verticillatæ raro subspiraliter dispositæ duplices, extrinsecus autem specie simplices. Bracteæ nisi ad apicem cum squamis concrescentes. Semina erecta.

Strobili squamæ usque ad apicem concrescentes demum carnosæ .... Subtribus I. JUNIPERINÆ.
Strobili squamæ basi tantum concrescentes, lignescentes.
Strobili squamæ valvatæ seu verticillatæ. Subtribus II. CALLITRINÆ.
Strobili squamæ decussatæ ...... Subtribus III. THUINÆ.

Folia mono- seu sæpius dimorpha, opposita vel ternatim verticillata, patentia vel cum ramulis basi concrescentia. Flores masculi spicati axillares. Strobili carnosi.
Subtribus I. JUNIPERINÆ.
.... 1. JUNIPERUS.

Folia mono- vel dimorpha verticillata vel decussata, juventute linearia patentia, adulta cum ramulis compressis seu angulatis concrescentia. Flores masculi spicati terminales. Strobili lignosi, squamæ 4–8 verticillatæ. Ovula pauca vel plura.
Subtribus II. CALLITRINÆ.

Ramuli compressi, strobili solitarii axis haud productus; squamæ 4 .... 2. TETRACLINIS.
Ramuli angulati, strobili paniculati axis supra squamarum basin productus.
Squamæ 6 inæquales .... 3. CALLITRIS.
Squamæ 8 æquales .... 4. ACTINOSTROBUS.
Squamæ 4 æquales .... 5. WIDDRINGTONIA.

Ramuli compressi vel angulati; folia dimorpha, juniora libera patentia, adulta squamiformia appressa basi plus minus concrescentia. Strobili squamæ decussatæ vel subspiraliter dispositæ .... Subtribus III. THUINÆ.

Flores dioici; strobili squamæ tenues superiores tantum fertiles .... 6. FITZROYA.

Flores monoici; strobili squamæ incrassatæ.

Strobili squamæ basi horizontaliter patentes, apice peltatim expansæ, 2- vel plurispermæ .... 7. CUPRESSUS.

Strobili squamæ ascendentes oblongæ vel clavato-dilatatæ.

Squamæ 8–12 plus minus imbricatæ, semina utrinque æqualiter alata (exalata tamen in § *Biota*)...... 8. THUYA.

Squamæ 6 valvatæ medianæ tantum fertiles; semina apice oblique alata. 9. LIBOCEDRUS.

Tribus II. TAXODINEÆ, *vide* p. 20.

Tribus III. ARAUCARINEÆ, *vide* p. 24.

Tribus IV. ABIETINEÆ, *vide* p. 27.

JUNIPERUS.

A genus known in classical times, mentioned by Pliny and other authors, established botanically by Tournefort in 1700, adopted by Linnæus in 1737, and accepted with little or no modification by all subsequent botanists. It is well and sharply defined by its succulent cone-scales, which are confluent one with another at the base. The foliage is polymorphic.

The anatomical structure of the free leaves is substantially the same as that of the concrescent leaves. In both cases the stomata are nearly if not quite confined to the upper surface of the leaves. The resin-canals are close beneath the epidermis on the upper face of the leaf. The single fibro-vascular bundle occupies the centre of radiating rows of parenchymatous cells all containing chlorophyll, and more closely packed in the adnate than in the free leaves. A layer of exoderm cells (hypoderm) surrounds the leaves of both kinds immediately within the epiderm. In *Juniperus drupacea* there is one large single resin-canal near the phloem of the fibro-vascular bundle.

An examination of the course of development shows that the leaves, as in the case of so-called "decurrent" leaves, generally are free at the base at first, but subsequently are uplifted with the axis as it lengthens, and are partly concrescent with it instead of becoming detached.

The male flowers are catkin-like, axillary or terminal, placed at the end of short shoots, and show no intermediate forms between the foliage-leaves and the sporophylls or stamens. Anther-cells 4–8. The pollen-cells or microspores are globose. The succulent fruits ripen in the second year. Ovules erect, 2 to each scale, wingless. Cotyledons usually 2.

Three sections or subgenera have been established, dependent upon the freedom or union of the seeds, the "decurrence" or isolation of the leaves, and the perulate or eperulate buds. These three sections—*Caryocedrus* (Endlicher), *Oxycedrus* (Spach), and *Sabina* (Spach)—have also met with general acceptance. Haller's proposal in 1745 to constitute a distinct genus "*Sabina*" has not been adopted; nor has the genus *Arceuthos* of Antoine and Kotschy (1854), proposed in order to include *J. drupacea* (which Endlicher included in his section *Caryocedrus*), met with any greater degree of recognition. *Thuiæcarpus* of Trautvetter, Plant. Imag. ii. 16, is, judging from the figure, a monstrous form in which the fruit-scales are of a leafy consistence, separate at the tips so as to expose the seeds. As a malformation by arrest of development it is interesting, and also as showing an intermediate condition between the appearance of the fruit in *Juniperus* and in *Thuya* respectively.

The distribution of the species extends in the Old World, roughly speaking, from the Arctic regions of Europe and Siberia to Northern Africa, Abyssinia, Arabia, the Himalayas, and China. From West to East the species are found at intervals from Western Europe, the Azores and the Canary Isles, to Kamtschatka and Japan. In the New World they occur from the Arctic Circle to Mexico. On the eastern side *Juniperus virginiana* extends completely from the north to the south of North America. One species is found in the West Indies.

Numerically the largest number of species are found in the Mediterranean region and the Levant inclusive of Asia Minor. Next in number are the species found in the Atlantic islands of Madeira, the Azores, and Canaries. Three species are found in the Himalayas, as many in Japan and China. One inhabits Kamtschatka, and one N.W. America. There are three species in Mexico, four in the Eastern United States, and one in the West Indies. *J. communis* is distributed throughout the whole of Europe, in Siberia and Kamtschatka, especially in the form called *alpina* or *nana*, which occurs also both in Eastern and in Western North America. On the Alps this species extends upwards to 5000 feet.

In a fossil condition, according to Renault, Bot. Fossile (1885), p. 135, it occurs in Tertiary strata, in amber &c., but not frequently. Either its remains have not been preserved, or the genus, in spite of the simplicity of its structure, is of relatively late origin.

TETRACLINIS.

Under the name of *Thuya articulata* a remarkable Conifer, native of the Barbary States, was mentioned in Shaw's 'Travels in Barbary' (1738), and botanically described by Vahl in 1791. It was known to the Romans, who highly valued its timber, which is still used for ornamental purposes. Desfontaines adopted the name given by Vahl, but as the characters of the plant differ in many respects from those of *Thuya*, it has of late been generally included under the genus *Callitris*, of which *Frenela* is a synonym. Richard, Spach, Endlicher, Parlatore, and Ball all attribute the species *Callitris quadrivalvis* to Ventenat; but this, as was pointed out by Bentham, is an error, as Ventenat, when founding his genus *Callitris* upon an Australian evergreen tree, mentioned no species at all by name. Richard is responsible for the name *Callitris quadrivalvis*, while to Mirbel is to be credited the synonym *Frenela Fontanesii*. Spach takes it as the type of the genus *Callitris* in spite of its North-African origin, and Bentham makes it the representative of a section of the genus *Callitris* under the sectional name *Tetraclinis*.

Tetraclinis articulata, as we prefer to call it, has the articulate stems of *Callitris*, but differs in its flattened (not triangular), divaricate, Salicornia-like branches, its four-ranked, uniform foliage, and its solitary female cones consisting of four nearly equal decussate or pseudo-verticillate scales, at first somewhat fleshy, and with two equally winged, erect seeds to each scale. Traces of this bract are visible near to the apex of each scale. The axis of the cone is not prolonged beyond the scales as it is in *Callitris*. Desfontaines, 'Flora Atlantica,' t. 252, figures the male flowers as well as the cones. The fossil species from the Tertiary formations named *Callitris Brongniarti* (Renault, 'Cours de Botanique Fossile,' Conifères, tab. 15. fig. 9) appears to belong to this genus rather than to *Callitris* proper.

For a summary account of the Gum Sandrac tree of Marocco see Hooker and Ball, 'Marocco and the Great Atlas,' Appendix D; and Luerssen, 'Medicinisch-Pharmaceutische Botanik,' Band ii. (1882), p. 98, fig. 37.

CALLITRIS.

A genus established by Ventenat * in 1808 and founded upon a single evergreen Australian tree to which no specific name was attached, but which was probably that now known as *C. rhomboidea*. It is synonymous with *Frenela* of Mirbel, who, in 1826, substituted the name *Frenela* on account of the similarity of sound between *Callitris* and the Myrtaceous genus *Calythrix*.

The genus has been understood in various ways by different authors. Richard, Endlicher, Parlatore, Eichler, Bentham, and others refer the North-African *Thuya articulata* to this genus, but, for reasons cited under the preceding genus, it seems to me to be preferable to consider the Barbary plant as the representative of a distinct genus (see *Tetraclinis*). The South-African *Widdringtonia* (alias *Pachylepis* of Brongniart) is also often comprised under this genus, but this also I propose to keep separate. As thus circumscribed *Callitris* comprises only Australian and New-Caledonian species, but includes the genus *Leichartia* of Shepherd and the *Octoclinis* of F. von Mueller.

Callitris has its vegetative organs similar to those of its allies, but differs from them in the presence of 6–8 unequal verticillate scales to the cones and of numerous seeds to each scale. Unlike what happens in *Actinostrobus*, there is an abrupt transition between the leaves and the cone-scales, whilst these latter usually show externally traces of their essentially composite nature. The erect seeds, as may be seen from the cicatrices they leave when they fall from the scale, are arranged in a somewhat decussate manner: thus we see, first, one scar at the base in the middle line; then two at a higher level, one on each side of the centre; then one central, followed by two more lateral ones.

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* Dec. Gen. Nov. 1808, n. 10.

The germinating embryo shows two linear spreading epigeal cotyledons.

Various fossil species from the Miocene are referred to this genus (*Renault*).

ACTINOSTROBUS.

A genus established by Miquel in Lehmann's 'Plantæ Preissianæ,' i. p. 644 (1848). The vegetative organs closely resemble those of *Callitris*, the branchlets being articulated, 3-sided, and the homomorphic leaves are arranged in alternate, ternary whorls. Only the tips of each leaf are separate from the branch. The stamens are in whorls of three, and in six vertical ranks; the anther-cells are 2–4. The solitary female cones are borne on the ends of short, woody stalks, densely covered with six rows of appressed, deltoid or boat-shaped, membranous leaves, the uppermost of which are closely pressed against the scales of the cone. These latter form a whorl of six woody, oblong-acute scales equal in size, valvate at the edges, and surrounding a short conical prolongation of the central axis. There is absolutely no external indication of the composite nature of the fruit-scale in the ripe fruit, but on a microscopic examination of the scale a double series of vascular bundles becomes apparent. Of these bundles those nearest to the axis have their phloem turned towards it, whilst those on the dorsal or outer surface have the phloem directed outwards. The ovules are erect and 2–3-winged.

According to Sir John Lubbock, 'Seedlings,' vol. ii. p. 549 (1892), there are in this genus three linear subulate cotyledons, and the primary leaves are of the same form.

Only two species are known, both natives of Western Australia.

WIDDRINGTONIA*.

In the year 1833 Brongniart proposed the name *Pachylepis* for certain South-African plants allied to *Callitris*. This name was set aside by Endlicher on the ground that Lessing had previously described a genus of Composites under the same name. This latter genus is not generally accepted, and hence, on grounds of strict priority, Brongniart's name should be adopted; but, as it has not been taken up by any subsequent writer, it is more convenient to follow the generally adopted course and make use of Endlicher's name of *Widdringtonia*.

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* Endlicher, Synopsis Conif. (1847), p. 41.

The species differ from those of *Callitris*, to which they are sometimes referred, in habit and foliage, the branches being terete, the leaves opposite and decussate (not in whorls of three), or in the fast-growing shoots spirally arranged. The appearance of the inarticulated branchlets is more like that of *Thuya* or *Cupressus*, owing to some of the leaves being less concrescent than is the case in *Callitris*. The male catkins are terminal and very small, the anther-crest ovate, pointed, the anther-cells 2–3. The female cones in *W. cupressoides* are arranged along the sides of the branches, each cone subtended by a deltoid leaf. The cone-scales are four in number, equal or nearly so, decussate, or even somewhat spirally arranged, at first corky in substance, tubercled, and spreading to expose the young ovules, ultimately very thick, woody, and closed over the seeds. The seeds are thick, ovoid or trigonous, narrowly winged.

Two species are South-African; one has been discovered in Madagascar, one in Kaffraria (Baur, 1164), and one quite recently on the mountains of Equatorial Africa. Prof. Henriques, of Coimbra, has also favoured me with imperfect specimens from the Serra de Gorungosa at an altitude of 5300 feet, which appear to belong to this genus.

Endlicher's description of the female inflorescence is rather misleading, as tending to the inference that the female flowers are terminal instead of lateral.

Several fossil species are described from the Tertiary formations by Renault, 'Cours de Botanique Fossile,' Conifères, p. 131.

The genus is included in *Taxodineæ* by Parlatore, but the cone-scales are not spiral, neither is the bract externally visible. It seems, therefore, most in place among *Callitrinæ*, or as intermediate between that tribe and *Thuinæ*.

FITZROYA.

A genus established by Sir Joseph Hooker, in 1852, in the Journal of the Horticultural Society of London, vi. p. 264, upon an evergreen tree, native of Chile and Patagonia. To this was afterwards added by Bentham a Tasmanian plant previously referred by Hooker to his genus *Diselma* (Flor. Tasman. i. p. 353, t. 98). The leaves, so far as known, are homomorphic, arranged in alternating ternary whorls; the flowers are diœcious, the males at the extremities of the branches, and the broadly crested anthers 2–4-celled. Pollen-cells globose. Female cones solitary at the end of the branches. Leaves passing abruptly into the scales of the cones, which latter are decussate or verticillate, the uppermost alone fertile with 2–3, erect, 2-winged ovules to each scale. The complex nature of the fruit-scale is indicated by the sharp point which projects from the back of each scale near the top. Occupying the centre of the cone are two or three oblong obtuse processes similar to those which occur in *Actinostrobus*, which appear to originate from the central axis, but their precise morphological nature is at present unknown.

CUPRESSUS.

This genus was taken up by Linnæus in his 'Genera Plantarum' (1737), n. 1079, from Tournefort (1700). The French botanist in his turn had adopted it from the older writers. The word is mentioned by Pliny, Cato, and other classical authors. The typical species is that now known as *C. sempervirens*, around which others have been grouped, but in different manners, by different writers. Thus some plants which may fitly be referred to this genus have been placed under *Thuya*, *Thuyopsis*, *Platycladus*, and *Chamæcyparis*.

As here understood, it comprises trees with polymorphic foliage and monœcious flowers. The male flowers are at the end of the branches, the anther-scales pointed, pollen simple. The female flowers are solitary at the ends of short branches, rarely in groups, and ripening in the second year of their formation. The cone-scales show but slight traces externally of their composite nature, indeed Sachs says there is no seminiferous scale. Its presence may, however, readily be detected on microscopical examination. The seed-scales are arranged in decussate or verticillate whorls, each scale being dilated at the apex into a club-shaped expansion, flattened at the top, and with a short central mucro. The cones require two years to ripen (except those of the section *Chamæcyparis*); they are globular or oblong, the central scales alone fertile and bearing two or many seeds. Seeds winged on both sides.

Chamæcyparis differs in its two-ranked branchlets mostly in one horizontal plane, in the presence of a small number of seeds, generally two to each scale, and in the circumstance that the cones ripen in one season.

Thuyopsis, so far as the Japanese and the North-west American species are concerned, is also referable to this genus. *Retinospora* has no claim to generic distinction, the so-called species being merely phases of growth of certain species of *Cupressus*, *Thuya*, or *Juniperus*. Ferd. von Mueller, in his 'Select Plants for industrial culture,' correctly referred the Retinosporas to *Cupressus*.

The species are natives of the Levant, the Himalayas, China, Japan, North-western and North-eastern America, and Mexico.

Two species of *Cupressus* occur in a fossil state, the one in the Lower Eocene of Ireland, the other in the Middle and Upper Bagshot beds according to Starkie Gardner.

Thuya.

A generic name adopted by Linnæus in 1737 from Tournefort (1700) and older writers, the *thyon* of the Greeks being probably the plant here called *Tetraclinis articulata.* As here understood, the genus *Thuya* comprises the sections *Euthuya*, *Macrothuya*, and *Biota* of Bentham and Hooker. It is characterized by its flattened branchlets usually in one horizontal plane, the presence of dimorphic foliage, monœcious flowers, decussate stamens, 3–4 anther-cells, simple pollen; female cones solitary at the ends of the branches, ultimately pendulous (except in *Biota*), oblong or ovoid, rarely globose, ripening in the first year; the 4–6 scales decussate, slightly imbricate, oblong, acute, not peltately expanded as in *Cupressus*, the central ones fertile, or (in *Biota*) the lower ones. *Thuiopsis dolabrata* of Siebold and Zuccarini and *T. borealis* of Carrière belong more properly to *Cupressus*; whilst *Thuiopsis Standishii* is a true *Thuya* and the Japanese representative of the North-west American *T. gigantea.* The species occur in the Levant, the Himalayas, China, Japan, North-east and North-west America, and were widely distributed in both hemispheres in Miocene and Secondary times. See Brown of Campster, 'Monograph of *Thuya*.'

Libocedrus.

A genus founded by Endlicher in 1847, and admitted by subsequent writers under the same name or in the form of a synonym, such as *Heyderia*, Karl Koch (Dendrologie, ii. 172), or *Calocedrus*, Kurz (in the Journal of Botany, 1873, t. 133). It is very nearly allied to *Thuya*. The distinguishing characteristics are to be found in the four-sided male flowers, in the erect cones, the smaller number of scales, of which the central pair are fertile, and in the frequent coalescence of the two uppermost scales into a vertical septum. The seeds, moreover, are solitary and winged obliquely. The cotyledons are two.

The species are natives of China, the mountains of New Guinea (*Libocedrus papuana*, F. Muell.), North-west America, the Chilian Andes, and New Zealand (see R. Brown of Campster, 'Monograph of *Thuya*').

Species of this genus occur in amber and in the Miocene deposits of Spitzbergen and of Central Europe, and one species in the English Eocene below the London Clay (*Starkie Gardner*).

Tribus II. TAXODINEÆ, *Benth. et Hook. Gen. Plant.* iii. p. 422 (Taxodieæ).

Folia alterna raro subdecussata. Flores masculi spicati, umbellati seu paniculati, terminales vel axillares. Strobili squamæ spiraliter dispositæ manifeste duplices, cum bracteis tamen, nisi ad apicem, alte connatæ. Semina 2–9 erecta vel inversa.

Folia dimorpha, alia squamiformia alia cladodiiformia.
  Flores masculi umbellati .... 10. SCIADOPITYS.
Folia mono- vel heteromorpha nunquam cladodiiformia.
  Flores masculi spicati.
    Semina pendula; folia persistentia.
      Antheræ loculi 2; strobili globosi squamæ apice subpeltatæ pulviniformes mucronatæ........ 11. ATHROTAXIS.
      Antheræ loculi 4–5; strobili oblongi squamæ basi horizontaliter patentes, ad apicem peltatim dilatatæ .... 12. SEQUOIA.
      Folia decidua .... 13. GLYPTOSTROBUS.
    Semina erecta; folia persistentia; strobili squamæ laciniato-lobatæ.... 14. CRYPTOMERIA.
  Flores masculi paniculati.
    Folia decidua; strobili squamæ ascendentes lobulatæ .... 15. TAXODIUM.

SCIADOPITYS.

This singular genus was published by Siebold and Zuccarini in 1842, and has undergone no change of position.

The leaves are of very simple character, being little more than leaf-scales, deltoid in form, and somewhat concave. The fibro-vascular bundle is either not formed at all, or not till a late period. From the axils of some of these leaves arise the phylloid shoots or cladodes, which are peculiar to this genus, and have given rise to much discussion. The phloem is on the upper, the xylem on the lower surface of the vascular bundle, contrary to what happens in true leaves. A summary account of the structure of this plant, and a *résumé* of the opinions of various authors concerning it, is given in my paper on the comparative morphology of *Sciadopitys* in the 'Journal of Botany' for April 1884, as well as in my former communication to the Society. The male flowers are aggregated in dense catkin-like masses at the ends of the branches, stamens spirally arranged, the anther-crest pointed and surmounting two linear anther-lobes which open vertically. The female cones are erect, on the ends of short lateral shoots. Bracts partially concrescent with the scale, the upper portion of which is thick and cushion-like. Ovules numerous, pendulous. Seeds compressed and with a narrow wing. Cotyledons two, foliaceous, linear. Primordial leaves similar, but smaller and alternate. The only known species is a native of Japan.

ATHROTAXIS.

This genus, founded by D. Don, dates from 1839, and has been adopted by all subsequent writers, the only variation being in the spelling of the name, which by some is written *Arthrotaxis*, the real orthography being *Athrotaxis*, from ἀθρόος, crowded. The foliage is homomorphic, decussate, passing into spiral. Male flowers catkin-like, terminal. Stamens arranged spirally; anther-cells two. The pollen cells are globose or three-sided, with 2 or 3 bands. The cones are terminal, globose, somewhat woody, the constituent scales wedge-shaped at the base, horizontally spreading, clavately or somewhat peltately dilated at the apex, and with numerous 3–6-winged seeds, pendulous from the thickest part of the scale below the apex. The bract is concrescent with the scale for the greater part of its length, but is generally visible at the apex in the form of a projecting point, though Endlicher describes the scales as "ebracteate."

The anatomy of the leaf is briefly described by myself in the 'Gardeners' Chronicle,' 1885, August 29, p. 270, sub *A. cupressoide.*

The species are natives of Tasmania.

The resemblance to recent *Athrotaxis* of *Echinostrobus Sternbergii* *, from the Upper Oolite of Solenhofen, is very striking. Other closely allied species occur at Stonesfield and at Scarborough.

SEQUOIA.

Originally included under *Taxodium,* this genus was separated in 1847 by Endlicher, who even included it under *Abietineæ.* The foliage is homomorphic (or dimorphic in young trees of *S. sempervirens*), decurrent, spirally arranged or pseudo-distichous. The male flowers are catkin-like, stipitate, terminal, or on the ends of lateral shoots. Stamens arranged spirally. The anther-crest is ovate-convex, with 2–5 anther-lobes. Pollen simple. The female cones ripen in the second year, are terminal, the leaves passing gradually into the bracts, which in the young state are longer than the scales. The fruit-scales spring at right angles from the axis of the cone, are wedge-shaped at the base, clavately thickened above, and flattened at the summit in more or less peltate fashion as in *Cupressus.* Endlicher's statement that the scales are ebracteate is clearly the result of an oversight, as the bracts are very evident in the young condition and are generally conspicuous even in the mature state. Microscopic examination, of course, reveals the existence of the bracts. The inverted seeds have lateral wings. Cotyledons 4–6 (*Engelmann*).

In *Sequoia gigantea* the leaves are more or less angular, with the midrib prominent above. The exoderm is discontinuous, the palisade-cells on all sides, but the endoderm is not well marked. The fibro-vascular bundle is elliptic in section, undivided, and there is a single resin-canal of large diameter next to the phloem. The structure in *S. sempervirens* is similar, allowance being made for the flattened form of the leaf.

The two species, *S. gigantea* (Wellingtonia) and *S. sempervirens* (Red Wood), are natives of California. The genus was abundantly represented in the Tertiary and even in the Secondary epoch in Central Europe and Greenland.

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* See Renault, 'Cours de Botanique Fossile,' Conifères (1885), tab. 12. f. 4.

GLYPTOSTROBUS.

A genus separated in 1847 by Endlicher from *Taxodium*, and retained as separate by Parlatore, Eichler, and others. Bentham and Hooker, however, follow Brongniart and include it in *Taxodium*. It differs from that genus, however, in the tristichous or spiral, not distichous, arrangement of the deciduous foliage, and in the ovoid winged seed. The subglobose male flowers are on the ends of the lateral branches; anthers 3–4, globose. The female flowers are club-shaped, tapering at the base; the uppermost leaves appressed, imbricate, passing gradually into the bracts, which latter are almost entirely concrescent with the lobulate scale. The winged seed is usually described as erect, but it is certainly pendulous, being enclosed within a cavity at the upper part of the scale.

The species requires further investigation in the fresh condition. The only recent species is a native of China; but others existed in the Miocene period in Central Europe, Greenland, &c.

CRYPTOMERIA.

Founded by D. Don in 1839, this genus has met with general acceptance. The foliage is arranged spirally, heteromorphous; the adult leaves are markedly "decurrent." The male flowers are crowded in axillary spikes at the ends of the branches, with no intermediate leaves between the leaves and the anther-scales. Stamens spiral, connective pointed, with 3–5 globose anther-lobes; pollen-grains simple. The globular female cones are on the ends of the shoots, and ripen in the first year. The bracts are concrescent for the greater part of their length, leaving the pointed extremity free and recurved. The scales of the ripe cone spread horizontally at the base, and are wedge-shaped, obovate, thickened at the extremity and more or less deeply divided into sharply pointed lobes. Seeds 3–5 to each scale, erect, with a narrow wing. Cotyledons 2–3, linear or oblong, stomatiferous on the upper surface. Plumule with three longitudinal furrows.

The cones frequently exhibit median prolification, owing to the recurrence of growth at the apex after the formation of the seed-scales.

The only known species is Japanese.

Taxodium.

The establishment of this genus dates from the time of L. C. Richard (1810). Previous to that time the species were included under *Cupressus*. The deciduous foliage, very numerous panicled male flowers, and the spirally arranged cone-scales amply suffice to distinguish it. The anther-lobes are globose. The female cones are globular or oblong, the bracts nearly entirely concrescent with the thick coriaceous peltate scales, the stalk-like base of which springs at right angles from the axis of the cone. The lobulate extremity of the scale projects beyond the apex of the bract. The erect seeds are two to each scale, triangular, with very narrow wings at the angles. The leaves are heterotaxic —being sometimes distichous, at other times tristichous on the same branch, and varying also in size and form.

The roots are remarkable for the curious woody projections which they throw up; the nature and the purpose of these formations are still matters of controversy.

The hypocotyl has a thick cellular cortex traversed, just outside the pericycle, by a ring of air-passages of large diameter. The woody bundle has, on section, the shape of a 7-pointed star with pith in the centre surrounded by seven masses of xylem, outside of which is a thin layer of phloem-cells. No resin-canals are visible.

The cotyledons are three-sided, with the midrib prominent above. There is no hypoderm and no palisade, and the xylem and phloem form one undivided mass surrounded by an imperfectly-developed endoderm.

The species are natives of the Southern States of North America and of Mexico. In the Miocene period they spread over Central Europe, Spitzbergen, and Greenland.

Tribus III. ARAUCARINEÆ.

(Araucarieæ, *Benth. et Hook.*)

Antheræ loculi plerumque penduli liberi. Strobili squamæ spiraliter dispositæ specie simplices, bracteæ videlicet valde evolutæ, squamæ ovuliferæ autem imperfecte contextæ extus inconspicuæ. Semina libera vel cum squamis concrescentia pendula.

Monoica.

Semina 3 pendula libera	16. CUNNINGHAMIA.
Semina solitaria libera	17. AGATHIS.

Dioica.
Semina solitaria cum squamis concrescentia .... 18. ARAUCARIA.

CUNNINGHAMIA.

A genus founded by Robert Brown in 1826 upon a solitary Chinese species. The synonym *Belis* of Salisbury is earlier, Trans. Linn. Soc. viii. p. 315 (1807), and strictly should have precedence, but, owing to the similarity with *Bellis,* it has never been taken up, and it would be productive of unnecessary confusion to adopt it now. A still earlier name is *Pinus lanceolata.*

The lanceolate leaves are spirally arranged and uniform, the male flowers in terminal umbellate spikes. The anther-crest is serrulate, bearing three free pendulous anther-lobes. The female cones are aggregated or solitary on the ends of the branches; the bracts spirally arranged, wholly confluent with the seed-scale, which is reduced to a mere cellular projection, with no vascular connection between the central bundle of the bract, at least in the first instance. From this placental process hang three compressed seeds, each with a membranous wing. The attachment of the seed to the placental process or "*lamina ovulifera*" is very like what happens in the macrospore of *Isoëtes.*

The anatomical conformation of the bract is essentially the same as in Conifers generally; and as the bracts are in continuous series with the leaves, the cones of *Cunninghamia,* like those of *Agathis* and of *Araucaria,* are mainly composed of bracts, the true fruit-scale being reduced to a minimum (see Dickson, Edinburgh New Philosoph. Journal, vol. xiv. pt. 4, 1861). In the leaves of *Cunninghamia* there is well-marked palisade-tissue, but in the bracts this is replaced by ordinary parenchyma traversed by five resin-canals. The structure of the placental outgrowth seems to be exclusively cellular, at least for a considerable period.

AGATHIS.

Rumphius's name of *Dammara* has, as pointed out by Bentham, no real claim to precedence, hence Salisbury's name of *Agathis* (1807) is the one adopted in the 'Genera Plantarum.' The species are lofty trees with thick leaves spirally arranged. The male flowers are catkin-like, sessile or stipitate, axillary or super-axillary. The stamens are placed in a spiral series continuous with a number of perular scales, each stamen dilated at the top into a shield-shaped connective from the edge of which hang three or more anther-cells. The female flowers are globose, their scales spirally arranged, continuous with depauperate leaves at the base, and bearing no trace of their composite nature externally. Seed solitary, pendulous, with a single wing directed more or less horizontally to one side, in one instance I have seen two equal wings to the seed. As in *Cunninghamia*, the bract appears to form the greater mass of the fruit-scale, the ovuliferous portion being marked internally only by a thin placental line from which the seed hangs. Cotyledons two, leafy.

Resin-canals exist in the secondary liber only (*Renault*).

The recent species are of Southern type, occurring in Australia, New Zealand, some of the Pacific islands, as well as in Brazil and Chile.

Cones referable to this genus occur in the Cretaceous rocks.

ARAUCARIA.

In 1789 Jussieu proposed the establishment of this genus, which has been generally accepted, although by some its sections have been considered as distinct genera. In the young state the foliage is in some species heteromorphic; in the adult condition the leaves are arranged spirally, sometimes broad, in other species linear; its flowers are usually diœcious, the males in terminal, catkin-like masses solitary or fasciculate. Anthers numerous, with a prolonged connective from which hang 6–8 linear anther-cells. Female flowers terminal, the scales spirally arranged in continuous series with the leaves; the seed-scale usually not obviously distinguishable from the bract except by the aid of the microscope. Ovule solitary, pendulous, testa ultimately confluent with the scale. Cotyledons 2–4, epi- or hypogeal; tigellum cylindric or tuberous.

The genus is divided into sections according to the epi- or hypogeal mode of germination, the formation or otherwise of a tuberous tigellum, &c. *

Van Tieghem notes the presence of a resin-canal outside the phloem in the pericycle of the root—a character which this genus shares with *Agathis* and *Stachycarpus* (see the latter genus).

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* See Heckel, "Sur la germination des Graines d'*Araucaria Bidwillii* et *A. brasiliensis*," Comptes Rendus de l'Acad. des Sciences, Dec. 7, 1891, and Blanchard, in 'Revue Horticole,' July 1892, p. 276.

Resin-canals are present in the secondary liber. However characteristic these appearances may be they are ill-suited to the requirements of systematists and, indeed, are for the most part not available.

The species are natives of Australia, Brazil, and some of the South Sea Islands. Numerous allied forms are found in a fossil condition from the Carboniferous strata through the Oolitic and Miocene periods, showing the type to be one of great antiquity and simplicity of organization, unless, on the contrary, the almost complete fusion of bract and seed-scale and the relative insignificance of the latter are to be taken as evidences of higher organization.

Tribus IV. ABIETINEÆ, *Benth. et Hook.* iii. p. 423.

Strobili feminei squamæ spiraliter dispositæ manifeste duplices, e bracteis plus minusve liberis et e sporophyllis seu squamis seminiferis constantes. Semina 2 inversa libera.

* Folia pro maxima parte homomorpha.

Folia plana ad basin pulvinatim incrassata pulvinis decurrentibus .... Subtribus I. PICEÆ.
Folia petiolata a canali resinifero centrali solitaria percursa; amenta strobilique parvi.. 19. TSUGA.
Folia sessilia angulata vel plana, canalibus resiniferis duobus lateralibus vel nullis; amenta strobilique majusculi.................. 20. PICEA.
Folia ad basin haud pulvinatim incrassata.
Rami dimorphi alii elongati foliis sparsis, alii contracti foliis fasciculatis ...... Subtribus II. LARICEÆ.
Folia persistentia .... 21. CEDRUS.
Folia decidua.
Flores masculi solitarii amentiformes .... 22. LARIX.
Flores masculi umbellatim aggregati .... 23. PSEUDOLARIX.
Rami necnon folia sparsa homomorphi. Subtribus III. SAPINEÆ.
Flores masculi umbellati .... 24. KETELEERIA.
Flores masculi solitarii vel racemosi.
Strobili maturi squamæ ab axi secedentes. 25. ABIES.
Strobili maturi squamæ persistentes .... 26. PSEUDOTSUGA.

** Folia manifeste dimorpha, primaria sparsa, secondaria fasciculata .... Subtribus IV. PINEÆ.
27. PINUS.

TSUGA.

The Hemlock Spruces were originally comprised under *Pinus*. Link included them under *Picea*, others placed them under *Abies*. Carrière established them as a separate genus, in which he was followed by Engelmann. The branchlets are marked with the slightly prominent pulvini at the base of the leaves, the leaves themselves being apparently 2-ranked, mostly uniform in character, with a distinct stalk mostly appressed to the branch, flat, with a solitary resin-canal in the centre of the leaf between the midrib and the epidermis, and nearly, if not quite, in contact with both as in *Torreya*. The male flowers are stipitate, axillary, subglobose, and surrounded at the base with small perular scales. The anthers have a short spur-like or knob-like projection at the base, and open transversely. The pollen-cells are globose. The female cones are small, terminal, pendulous, with persistent scales and inconspicuous or concealed bracts. The winged seeds are very small. The cotyledons are 3–5, linear-oblong, with stomates on the upper surface. The primary leaves are similar to the cotyledons and alternate with them, but with stomata on the lower surface.

The genus is very nearly allied to *Picea*, but the habit, the leaf-structure, which is quite peculiar, and the floral characters combine to constitute a distinct group. By Lemmon and other authors the Californian *T. Pattoniana*, which differs in the arrangement of the leaves from the other species, has been made the representative of a distinct genus, *Hesperopeuke*. Van Tieghem (Bull. Soc. Bot. France, 1891, p. 414) supports the separation on anatomical grounds, showing that the midrib is prominent, not sulcate, on the upper surface, the stomates on both surfaces instead of on one only, the resin-canal separated from the pericycle by a few cells instead of being in contact with it as in *Tsuga*. *Tsuga* proper and the section *Hesperopeuke* have, according to Van Tieghem, a central resin-canal in the pith of the root (Bull. Soc. Bot. France, 1891, p. 406).

The species are distributed in North-western and in North-eastern America, the Himalayas, China and Japan.

PICEA, *Link*.

This includes the Spruce-firs, which are now, by almost universal consent, called by this generic name unless perhaps in

English gardens, wherein D. Don's plan of calling the Silver Firs *Picea* and the Spruces *Abies* is still followed. As the precise application of the classical words is a matter of controversy, there is not, except for the sake of uniformity, much preference either way*. The genus *Picea* as here understood consists of trees with angular or flat leaves springing from well-marked pulvini. The stipitate male flowers are axillary or terminal, the stipes surrounded by perulæ. The connective of the anther is prolonged into a rounded toothed crest, the cells dehiscing lengthwise; pollen as in *Pinus*. The female cones are at the ends of the branches, erect, or generally ultimately pendulous. Seed-scales persistent, always longer than the bracts; seeds without resin-vesicles. The direction of the cones varies according to age, and but little stress can be laid upon it as a distinguishing characteristic. The cotyledons vary from 5–15 in number, are 3-sided, and, like the primary leaves, are toothed at the edges.

The genus is marked out into two sections by the nature of the leaves, which in the true Spruces, § *Genuinæ* of Link, are tetragonal and with uniform parenchyma; while in the § *Dehiscentes* of Link (which is nearly equivalent to the later published § *Omorica* of Willkomm) the leaves are more flattened, less distinctly tetragonal, and with palisade-cells and stomata on the upper portion of the leaf. This last section includes a North-west American species, two or three Japanese species, and one lately discovered in Servia, *P. Omorica*, which Wettstein† considers may be a survival from the Tertiary period. The leaf-structure of this species is different from the Japanese and North-west American species with which it has been sought to associate it. It has no palisade-tissue, and the resin-canal is on the phloem side of the leaf.

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* "Piceam vocavi cum antiquissimis Botanicis omnibus præter Dodonæum. Hunc Linnæus secutus Abietem vocavit. Nomen Linneanum non mutarem nisi Du Roi et Pottius initium fecissent, quos multi alii secuti sunt, ita ut par sit ratio quos sequi velles."—Link, Abiet. Hort. Berol. Cult. in Linnæa, xv. p. 517 (1841). See also Jas. Backhouse in 'Gardeners' Chronicle,' Nov. 27, 1886, in which the question is ably discussed; the writer, whose opinion is entitled to most respectful consideration, arguing that Linnæus was correct in his identification of the classical plant, and that his nomenclature should in consequence be followed.

† Wettstein, "Die Omorika Fichte," Sitzber. d. Akad. d. Wissenschaft in Wien, Bd. ic. 55, Taf. 5.

Resin-canals occur in the wood of the various species of *Picea*, but they are absent in that of *Abies*. The old bark, too, according to Schacht, has masses of sclerous cells dispersed throughout it.

From anatomical reasons only, Bertrand includes with *Picea* the *Pseudotsuga* (Douglas Fir) and the *Tsugas* (Hemlock Spruces).

The geographical distribution of the Spruces is nearly the same as that of the species of *Pinus* (see p. 38); but none have yet been found in the Tropics, even on the mountains. Traces of the foliage and cones are found in beds of the Miocene period and in amber.

CEDRUS.

The Cedars, at least that representative of the genus which has its home on the slopes of Lebanon, has been distinguished from the earliest times. In a technical sense, however, the genus *Cedrus* does not go further back than the date of Loudon's 'Arboretum'!, the *Cedrus* of Miller (1733) being referable to *Swietenia*.

By various authors the Cedars have been included under *Abies*, *Larix*, or *Pinus*; but the characters of the foliage separate them from either of those genera, as do the male flowers, which are solitary on the ends of the shortened branches or "spurs." The anthers have a lacerated connectival crest, and their two cells open lengthwise. The pollen-cells are globose, or somewhat bilobed from the presence of a broad central band, but are destitute of the winged appendages seen in the pollen of *Pinus*. The cones are erect, their scales are like those of *Abies*, but persist longer, and do not leave a central core or axis after the scales have fallen. The bracts are shorter than the scales. The seeds have large hatchet-shaped wings. The cotyledons are about 9 in number, somewhat 3-sided. The primary leaves are scattered (not tufted), somewhat cylindric; and each springs from a thickened base, somewhat as in *Picea*. Stomata occur on all sides.

In the hypocotyl of *Cedrus Deodara* there is a cellular cortex, and within the pericycle are four masses of xylem on the outside of a central pith, and alternating with a corresponding number of groups of phloem. In the root the xylem forms a triangular mass in the centre without any pith, but with three phloem masses outside.

The leaf-structure is the same in all the forms. Beneath the epiderm is a double layer of hypo- or exoderm surrounding the mesophyll, which consists of uniform parenchyma destitute of palisade-cells; but the lining of the cells is sinuous, as in *Pinus*. The endoderm is well marked, and the fibro-vascular bundle single. The two resin-canals are in contact with the lower epiderm. According to Van Tieghem, a central resin-canal occurs in the pith of the root.

A peculiarity observed in the Deodar may be mentioned with a view of ascertaining its constancy or otherwise, viz., the disarticulation that takes place between the top of the filament and the base of the anther, so that when the former falls off the axis of the male spike is left with little projecting pegs, which are the remains of the filaments.

The species occur in the Atlas Mountains of Algiers, the mountains of Lebanon, the Cilician Taurus, Cyprus, and in the Himalayas and Tibet. Sir Joseph Hooker considers that the so-called species are geographical varieties derived from a common stock (Natural History Review, January 1862).

Cones referable to this genus have been met with in the Lower Greensand beds of the Isle of Wight.

LARIX.

The Larches have been distinguished from time immemorial; but botanically they have been included under *Pinus* or *Abies*. The genus *Larix* was mentioned by Tournefort in 1700, and was adopted by Haller, Linnæus, Miller, Salisbury, and others. The resemblance to the Cedars is striking; but in the Larches the foliage is deciduous, the male flowers are sessile along the lateral branches (of the previous year's growth), the bracts are longer and more conspicuous in the young state. The anthers have a sharply pointed connective, and open lengthwise. The pollen-cells are globose. The cones are at first nearly horizontal, afterwards assurgent; their scales spring from the axis at right angles, and are then bent upwards, as may be seen in longitudinal section. In the young state the seed-scale is stipitate and quite separate from the bract springing from the axis above it.

The cotyledons are 6, entire. The primordial leaves are flat, pulvinate at the base, stomatiferous on the lower surface, and usually much shorter than the cotyledons. The leaves have a double layer of hypoderm, uniform parenchyma, a single fibro-vascular bundle, surrounded by endoderm, and two resin-canals near to the epidermis on the lower surface.

Van Tieghem describes the young root as having a resin-canal in the pericycle opposite each mass of xylem, as also in *Pseudotsuga*, *Picea*, and *Pinus* (Bull. Soc. Bot. France, 1891, p. 415). Resin-canals also occur in the cortex and in the secondary wood. The medullary rays have no pits, and isolated sclerous cells occur in the old bark (Schacht).

The species are distributed over the northern hemispheres of both continents, and fossil remains are found in Central Europe in the beds of Miocene age.

PSEUDOLARIX.

This genus was established in 1848 by Gordon in his 'Pinetum,' the only representative being a singular Chinese tree with deciduous leaves in tufts, like those of the Larch. Some hesitation was felt as to the acceptance of this as a distinct genus; but now that the male flowers are known, there is no longer any ground for doubt. (See Masters in Journ. Linn. Soc., Bot. vol. xxii. tabb. 9, 10.)

The male flowers are catkin-like, stipitate, pendulous, and borne in umbels on the apex of short thick branches or "spurs." The connective is prolonged into two sharp points, the two anther-lobes open lengthwise, and the pollen-grains are winged, as in *Pinus*, and very different from the simple pollen of *Larix*. The wing of the seed is obliquely lanceolate. I have not seen the process of germination. The distinctive criteria afforded by the external anatomy are supported by the differences in anatomical structure. The epidermis is papular. The hypoderm is discontinuous, the palisade-cells developed. The fibro-vascular bundle is divided and surrounded by the endoderm. Very large stereome-cells occur between the two divisions of the bundle. The resin-canals are four in number and subepidermal—two lateral, two median. Van Tieghem * also indicates the existence of a single resin-canal in the centre of the young root, as in *Abies*, *Keteleeria*, *Cedrus*, *Hesperopeuke*, and *Tsuga*. The bract and scale are confluent at the base; but the vascular bundles which enter the scale are quite distinct from those which enter the bract.

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* Van Tieghem, Bull. Soc. Bot. France, 1891, p. 413.

KETELEERIA.

This genus was proposed by Carrière in the 'Revue Horticole,' 1866, p. 449, for the reception of the tree more generally known as *Abies Fortunei.* The history of this remarkable tree, up to 1886, was summarized by myself in a paper published in the Journal of this Society, Bot. vol. xxii. p. 197. I then, like most of my predecessors, considered it a peculiar species of *Abies.* In 1887, however, Professor Pirotta, of Rome, had an opportunity of examining the male flowers, some of which he kindly communicated to me. The Italian professor came to the conclusion from this new evidence that Carrière's genus *Keteleeria* should be maintained as distinct from *Abies* *.

In addition to the other remarkable characteristics, such as the prominence of the midrib on the upper surface of the leaf, the male flowers were now seen to be in umbellate groups, quite unlike the solitary arrangement in *Abies* or *Picea.* Singularly enough this arrangement of the male flowers is met with also in *Pseudolarix Kæmpferi*, also an anomalous species, in *Cunninghamia* and in *Ginkgo*, all Chinese or Japanese plants. The anthers of *Keteleeria* dehisce transversely as in *Abies*, and the pollen-grains are of the same shape as in that genus.

The mode of germination of *K. Davidiana*, which I had the opportunity of examining at Kew in 1889, is unlike that of any species of *Abies* or *Picea*, and more closely resembles that of *Podocarpus.* The seedling plant is provided with two linear cotyledons as in that genus, whilst the resemblance of the adult foliage to that of *Podocarpus* has been frequently noticed.

From anatomical reasons chiefly, Bertrand, Ann. Sc. Nat. sér. V. xx. (1874) p. 87, described a second Chinese species as *Pseudotsuga Davidiana* †. This is the plant whose mode of germination has just been alluded to. Franchet, in the 'Nouvelles Archives du Muséum,' sér. II. 1884, t. 13, gave a fuller and more complete account of the same species under the name of *Abies Davidiana.*

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* Pirotta, "Sulla structura anatomica della *Keteleeria Fortunei,*" Ann. R. Istitut. di Roma, vol. iv. p. 200.

† It is worthy of note that Bertrand gives the name *Pseudotsuga* to a subgenus of *Picea*, but, nevertheless, he employs the subgeneric name in such a way as to induce the reader to consider it of generic value.

He also published excellent illustrations of the cone and of the foliage. Franchet remarks that this species bridges over the difference between the Piceas or Spruces, and the Tsugas or Hemlocks. The leaf-structure, however, as described by Van Tieghem, in the 'Bulletin de la Société de Botanique de France,' 1891, p. 412, by Bertrand, in Ann. Sc. Nat. sér. V. xx. (1874), and by myself in the 'Gardeners' Chronicle,' in 1884, March 15, p. 348, and in 1887, April 9 (*Abies Davidiana*), by no means corresponds with the structure either of *Picea* or of *Tsuga*, but is much more like, though not quite identical with, that of *Abies*. This is one of the genera mentioned by Van Tieghem as possessing a resin-canal in the centre of the pith of the root. In addition to *Keteleeria Davidiana*, M. Franchet describes and figures a second species which he calls *Pseudotsuga sacra*, but this appears too closely allied to *A. Davidiana* to merit a separate name. Other species of the genus *Keteleeria* are represented in the Kew Herbarium by a specimen from the Hong Kong Botanic Garden (Ford, 386!), and by one collected by the Rev. E. Faber near the summit of Omei, Szechuan, and possibly by still another from Dr. Henry.

ABIES.

A classical name taken up by Tournefort and adopted by Linnæus (1737). Great confusion has arisen from the different senses in which the names *Abies* and *Picea* have been employed by modern writers; it is, however, unnecessary to occupy space here with the discussion of this matter. Following Link, Bentham and Hooker and almost all European and American botanists now make *Abies* to include the Silver Firs, while *Picea* comprises the Spruces. The contrary custom is followed almost exclusively by English nurserymen, who have retained the arrangement proposed by D. Don, Loudon, and Gordon. The matter is referred to under the head of *Picea* (p. 28) and need not be further alluded to here.

Abies, in the sense limited by Link and adopted by most modern authorities, comprises *Abietineæ* with flat, spreading leaves which, in falling from the stem, leave circular scars with scarcely any swelling or pulvinus at the base. The male flowers are catkin-like, oval, or cylindrical, slightly stalked, the stalk surrounded at the base by perular scales. The anthers dehisce transversely, and have a knobbed connective. The pollen-cells resemble those of *Pinus*. The ripe female cones are erect, the bracts at first longer than the scales, which latter, when ripe, fall away with the seeds from the central axis or core, which remains on the branch erect and bare long after the scales have fallen. To some of these characters there are occasional exceptions, but on the whole the genus is well marked.

A section of a young rootlet of *Abies Pinsapo* shows no hypoderm, but a thick cortex limited by an endoderm, a circular pericycle enclosing a central triangular mass with xylem at the angles and phloem in the intervals. In the centre is a central resin-canal.

In the hypocotyl the section of the bundle is circular, the xylem, in the form of a ring, with disconnected masses of phloem outside. No resin-canal is apparent in the central pith.

The cotyledons of *A. Pinsapo* have the midrib prominent on the upper surface, no hypoderm, a single bundle with a circular section and of the usual construction. The resin-canals are in the lower parenchyma of the cotyledon near the epiderm.

The structure of the adult leaves is well known. For systematic purposes the relative position of the resin-canals is the most important point, their position being either close to the epiderm, or in the substance of the leaf-cortex, or close to the pericycle. The existence and degree of development of the hypo- or exoderm is by no means so useful, being dependent on local conditions.

The species of *Abies* have, broadly speaking, the same distribution as those of the genus *Pinus* (see pp. 37, 38), but do not enter the Tropics even on the mountains. The genus is not represented in China, and only one species occurs in Canada. Their geological distribution also seems to have been very similar. One species is recorded from the Wealden.

PSEUDOTSUGA.

A genus established by Carrière, 'Traité Général des Conifères,' édit. 2, p. 256 (1867), to include the noble Douglas Fir. Though closely allied to *Abies* and to *Picea*, the Douglas Fir does not fit in well with those or any of the other established genera.

The male flowers resemble those of *Picea*, to which genus there is also a resemblance in the pulvini of the leaf. It differs from *Abies* in the anthers, which are spurred at the back and open longitudinally. The pollen-grains are large, $\frac{1}{500}$ in. diam., globular, and unprovided with air-sacs. The female cones are at first erect, afterwards pendulous, the bracts projecting beyond the scales, and markedly 3-lobed at the free end. The cone-scales are persistent as in *Picea*. The seeds have no resin-vesicles. Cotyledons 5–7, linear, with stomata on the upper surface. Primordial leaves of the same form as the cotyledons, but only about half the length.

The wood is remarkable for the spirally-marked tracheids that it contains. The leaves are grooved on the upper surface, possess a broken layer of hypoderm, three rows of palisade-cells, sinuous cells surrounding a single fibro-vascular bundle, and resin-canals on the under surface next to the epiderm. Stomata occur on the lower face only. In the var. *macrocarpa* the form of the leaf is a little different, and in the mesophyll occur large, branching, sclerous cells, which I have not observed in the typical form.

In the young root I find a cortex with no exoderm, a central bundle, elliptical in section, with masses of xylem at the two ends and alternating groups of phloem. Resin-canals exist in the cortex close to the xylem. In the hypocotyl there is a thick cellular cortex, no exoderm, and no distinct endoderm. The bundle consists of three groups of xylem, alternating with an equal number of phloem-masses and surrounding a large-celled pith.

The cotyledons show the midrib prominent on the upper surface, an epiderm, no hypoderm, a cellular cortex with the cells slightly sinuous; a cylindric pericycle with an undivided mass of xylem resting upon a corresponding mass of phloem. The resin-canals are subepidermal.

The species occurs in North-west America, from Vancouver's Island to Southern California, extending inland to the Western slopes of the Rocky Mountains, and from the sea-level to an altitude of 10,000 feet in the mountains of Colorado (*Sargent*).

PINUS.

A genus known and distinguished in classical times, adopted by Tournefort (1700), and taken up by Linnæus in 1737. It has, however, been understood by different authors in widely different senses, Parlatore even going so far as to comprise within its limits not only the Pines proper, but also the Cedars, Larches, Silver Firs, and Spruces, in fact all the *Abietineæ*. A more convenient as well as a more natural arrangement is that adopted by Engelmann, Bentham, Eichler, and most recent authors, who include under *Pinus* all those *Abietineæ* with dimorphic foliage consisting of scattered primordial leaves and of secondary or foliage leaves arranged in fascicles of two, three, or five, the leaf-tufts surrounded at the base by imbricating perular scales. The male flowers are arranged in closely-crowded spikes, the anthers open lengthwise to liberate the pollen-grains, which have two membranous wings projecting from the central globular mass. The female cones ripen in the second year, the constituent scales being more or less woody and persistent, while the bracts are inconspicuous and wholly concealed by the scales. The cotyledons are numerous, the primordial leaves of the same shape, scattered, and each finely toothed at the margin and often slightly "decurrent" at the base. The caulicle is usually well marked, cylindrical, and coloured. The internal structure shows a thick cellular cortex sometimes penetrated by resin-canals (*P. Torreyana*) opposite the xylem, which latter forms a perfect ring surrounded by a discontinuous zone of phloem. In the centre of the bundle is a mass of pith. In *P. insignis* the structure of the tigellum is quite similar, thus showing an intermediate condition between that of root and of stem.

The root of *P. insignis* shows a cortex, no defined endoderm, a central entire mass of xylem with four separate masses of phloem on the outside. Resin passages exist between the groups of phloem-cells. The cotyledons vary in form according to their number and the way in which they are packed, but their structure is similar in all cases and shows an epiderm, no hypoderm, a thick cellular cortex, a central fibro-vascular bundle circular or elliptic in section with ill-defined endoderm, a crescentic band of phloem, and a single mass of xylem.

The primordial leaves (*P. Lambertiana, insignis, pinea*), like the cotyledons, show a simpler and less differentiated structure than in the leaves. There is no hypoderm and there are no palisade-cells. The resin-canals have the same relative position as in the adult leaves. It is noteworthy that the structure of the primordial leaves of *Pinus* presents a close approximation to that of the 4-sided leaves of *Picea*, but these have well-marked hypoderm.

The structure of the adult leaf varies slightly in different species. Usually there is a well-developed hypo- or exoderm, sinuous parenchyma, and a single or divided fibro-vascular bundle according to the shape of the leaf. The resin-canals vary in position, being in some species close to the epiderm, in some close to the endoderm, and in other species in the parenchyma between the two. The cells of the parenchyma are usually sinuous in outline, owing to the intrusion of folds of the cell-wall into the cavity of the cell.

Resin-canals exist in the old wood as well as in the cortical parenchyma.

The structure of the cone-scale with its double fibro-vascular layer is well known. The wing of the seed consists of wholly regular rows of cubical cells with undulating outline.

The species occur in the northern hemispheres of both continents on the mountains, in the valleys, and by the sea-coast. Some extend even into the Tropics, the West Indies, Malaya, and the Philippines. The genus was extensively represented in the Miocene period.

Geographical Distribution.

In the accompanying tables (pp. 40, 41) I have endeavoured to show the main features of the geographical distribution of the genera. The areas I. to VI. are those proposed by Sclater and Wallace and adopted more or less fully by most modern writers. The 23 "tabulation" subareas (p. 42) are taken from Clarke's paper in the 'Philosophical Transactions'; but instead of arranging them in linear series I have placed them, first of all, in a Northern and in a Southern division, and then side by side from West to East, as they would be in a map on Mercator's projection.

In arctic and in subarctic America a very few species extend across the continent, but for the most part the species to the west and those to the east of the Rocky Mountains, though closely allied, are different. The two series converge towards Mexico and Guatemala, and with this group also the West Indian species may for this purpose be associated. Although the Andes form, as it were, a continuation of the Rocky Mountains, no true Conifers are found on them, their place being filled by Podocarps and Taxads working upwards from the south. Among Taxaceæ *Dacrydium* and *Podocarpus* occur both in the northern and in the southern subdivisions of the globe. Among true Conifers, *Juniperus*, *Libocedrus*, and *Pinus* are the only genera found both north and south of the Equator. *Taxus* in the north and *Podocarpus* in the south belt the globe with but few breaks. *Torreya* has a curious distribution, being met with in both the Pacific and South Atlantic States of North America and in Japan and China.

China and Japan are both remarkable for the number and variety of their Taxads and Conifers, whilst two genera, *Pseudolarix* and *Keteleeria*, are, so far as known, confined to China, and *Cunninghamia* only occurs in China and in Cochin China; *Gingko* is of Chinese origin, but cultivated also widely in Japan. *Sciadopitys* is exclusively Japanese; whilst some of the species are common to both countries, there are several which are peculiar to Japan or to China. It is singular that these Sino-Japanese genera just mentioned, though belonging to different tribes and even orders, have all (except *Sciadopitys*) one character in common in the umbellate disposition of their male flowers, a peculiarity not met with in other genera.

Amongst the true Conifers representatives of the genera *Juniperus*, *Cupressus*, *Picea*, *Abies*, and *Pinus* may be mentioned as occurring in all or nearly all the subareas of the Northern hemisphere from West to East. In the South amongst the true Conifers there is no such continuity from West to East, though *Araucaria* is common to Eastern South America, Chile, Australia, New Zealand, and some of the South Sea Islands.

In the tables I have, as previously stated, followed C. B. Clarke as to the subareas proposed by him for statistical uses only, but for purposes of this communication I have been obliged to divide subarea 11 into a northern and a southern subdivision.

The asterisks (*) denote the occurrence of the genera in the several subareas, whilst the crosses (×) indicate the existence of fossil representatives in the districts in question. In some cases, such as *Pinus*, *Juniperus*, living and fossil representatives are found in the same area, but these cases have not been specially noted. The details relating to the fossil Conifers have been mostly taken from Renault's 'Cours de Botanique Fossile,' Conifers (1885). The relation between the distribution of Conifers and the direction of the great mountain-systems, whether in the East or in the West, is too obvious to need comment.

TAXACEÆ.

North.

WESTERN.					EASTERN.						
Areas	V.			VI.	I.			III.			
Subareas	16.	17.	18.	19.	1.	2.	3.	8.	9.	10.	11 N.
Ginkgo	×	×	...	...	×	...	×	...	*	*	
Cephalotaxus ...	...	...	...	...	...	...	...	*	*	*	
Torreya	×	*	*	...	...	...	...	...	*	*	
Taxus	*	*	*	*	*	*	*	*	*	*	
Podocarpus	...	...	...	*	×	×	...	*	*	*	*
Dacrydium	...	...	...	...	...	...	...	*	...	...	*
Phyllocladus	...	...	...	...	...	...	...	...	...	...	*

South.

WESTERN.					EASTERN.								
Areas	VI.				II.				IV.				III.
Subareas	20.	21.	22.	23.	4.	5.	6.	7.	12.	13.	14.	15.	11 S.
Ginkgo	..	...	...	...	...	...	...	..	×				
Pherosphæra	...	...	...	...	...	...	...	...	*				
Phyllocladus	...	...	...	...	...	...	...	...	*	*	...	...	*
Dacrydium	...	...	...	*	...	...	...	...	*	*		...	*
Podocarpus	*	*	*	*	*	...	*	*	*	*	* *	...	*
Stachycarpus ...	*	...	...	*	...	...	...	...	*	*			
Saxegothea	...	...	...	*									
Microcachrys ...	...	...	...	...	...	...	...	...	*				

CONIFERÆ.

NORTH.

	WESTERN.				EASTERN.						
AREAS	V.			VI.	I.			III.			
Subareas	16.	17.	18.	19.	1.	2.	3.	8.	9.	10.	11 N.
Juniperus	*	*	*	*	*	*	*	*	*	*	
Tetraclinis.........	...	...	...	...	...	*					
Callitris...........	...	...	...	...	×						
Cupressus	*	*	*	*	×	*	...	*	*	*	
Thuya	*	*	*	...	×	×	...	...	*	*	
Libocedrus	...	...	*	...	×	...	...	...	*		
Widdringtonia ...	...	...	...	...	×						
Sciadopitys	...	...	...	...	...	...	...	...	...	*	
Sequoia	×	×	*	...	×						
Glyptostrobus ...	...	×	...	...	×	...	...	...	*		
Cryptomeria	...	...	...	...	...	...	...	...	*	*	
Taxodium	×	*	...	*	×						
Cunninghamia ...	...	...	...	...	×	...	...	...	*		
Agathis	...	...	...	...	×	...	...	...	...	...	*
Araucaria	...	...	...	...	×						
Tsuga	*	*	*	...	...	...	...	*	*	*	
Picea	*	*	*	...	*	*	*	*	*	*	
Cedrus	...	...	...	...	×	*	...	*			
Larix...............	*	*	*	...	*	...	*	*	...	*	
Pseudolarix	...	...	...	...	...	...	...	...	*		
Keteleeria	...	...	...	...	...	...	...	...	*		
Abies	*	*	*	*	*	*	*	*	*	*	
Pseudotsuga	*	...	*								
Pinus	*	*	*	*	*	*	*	*	*	*	*

SOUTH.

	WESTERN.				EASTERN.								
AREAS	VI.				II.				IV.				III.
Subareas	20.	21.	22.	23.	4.	5.	6.	7.	12.	13.	14.	15.	11 S.
Juniperus	...	...	...	...	*								
Callitris...........	...	...	...	...	...	...	...	...	*	...	*		
Actinostrobus ...	...	...	...	...	...	...	...	...	*				
Widdringtonia ...	...	...	...	...	...	*	*	*					
Fitzroya...........	*	...	...	*	...	...	...	...	*				
Libocedrus.........	...	...	...	*	...	...	...	...	...	*	*		
Athrotaxis.........	...	...	...	...	...	...	...	...	*				
Agathis	...	...	...	...	...	...	...	...	*	*	*	...	*
Araucaria	...	...	*	*	...	...	...	...	*	*	*		
Pinus..............	...	...	...	...	...	...	...	...	...	...	...	...	*

NOTE.—The "tabulation" areas and subareas proposed by Mr. C. B. Clarke in his paper on "Biologic Regions and Tabulation Areas," published in the 'Philosophical Transactions,' vol. 183. (1893), p. 371, are the following, the names of which sufficiently express their limitations:—

Area I. PALÆARCTICA.
  Subarea 1. *Europa frigidior.*
    2. *Mediterranea.*
    3. *Mongolia.*
Area II. ÆTHIOPIA.
  Subarea 4. *Africa Tropica borealis.*
    5. *Africa Tropica australis.*
    6. *Caput* (*i. e.* extra-tropical S. Africa).
    7. *Mascarenia* (Madagascar and neighbouring islands).
Area III. INDO-CHINA.
  Subarea 8. *India Orientalis.*
    9. *China.*
    10. *Japan.*
    11. *Malaya* (Siam, Sumatra, Borneo, Java, Ins. Philipp.).
Area IV. OCEANIA.
  Subarea 12. *Australia.*
    13. *Nova Zelandia.*
    14. *Polynesia.*
    15. *Ins. Sandvicenses.*
Area V. NEARCTICA.
  Subarea 16. *Canada.*
    17. *America Boreali-orientalis.*
    18. *America Boreali-occidentalis.*
Area VI. NEOTROPICA.
  Subarea 19. *America Centralis.*
    20. *Andia Tropica.*
    21. *Brasilia Borealis.*
    22. *Brasilia Australis.*
    23. *Argentina.*

For a discussion on the construction and the assigned limitations of these several areas and subareas, the reader is referred to Mr. Clarke's paper.

On the Life-history of the Æcidium on *Paris quadrifolia*. By CHARLES B. PLOWRIGHT, M.D., and W. THOMSON. (Communicated by the President.)

[Read 16th February, 1893.]

PUCCINIA PARIDIS.

THE Æcidium on *Paris quadrifolia* is a very rare fungus in Great Britain, having so far only been recorded as occurring near Carlisle, where it appears in but small quantity. It was first found in May 1890 by Mr. W. Thomson, who has this year cooperated with me in working out its life-history. After considerable difficulty, we have succeeded in demonstrating that it is connected with a *Puccinia* on *Phalaris arundinacea*. This last-named plant has already been shown to be the host of no less than four species of *Puccinia* whose æcidial host-plants are not interchangeable, viz.:—

Puccinia sessilis on *Allium ursinum.*
„ *Phalaridis* „ *Arum maculatum.*
„ *Digraphidis* „ *Convallaria majalis.*
„ *coronata* „ *Rhamnus Frangula.*

Dr. H. Klebahn, of Bremen, further finds that it harbours a *Puccinia* whose æcidiospores occur on *Convallaria Polygonatum*; but whether this be specifically distinct from *P. Digraphidis* has not yet been ascertained.

The teleutospores of *P. Paridis* germinated in April; but when applied to *Arum maculatum*, *Allium ursinum*, and *Convallaria majalis*, produced no result. When placed upon the foliage of *Paris quadrifolia*, however, in two separate cultures, each of which included more than one plant, they gave rise to the æcidium. Control plants of *Paris quadrifolia* remained healthy.

It is very remarkable that *Phalaris arundinacea* should be the host of so many *Pucciniæ*: it is a widely distributed plant, but some of the host-plants of the various æcidiospores are very local in this country. It would seem as if these *Pucciniæ* were the survivors from a period when their respective æcidial host-plants were far more abundant than is the case at the present time.

Appended are the results of our cultures in a tabular form.

No.	Infecting material.	Plant infected.	Date of infection.	Date of first result.
1217.*	*Puccinia Paridis.*	*Arum maculatum.*	26 April.	
1218.	„ „	*Allium ursinum.*	26 April.	
1219.	„ „	*Convallaria majalis.*	26 April.	
1220.	„ „	*Paris quadrifolia.*	14 May.	25 May.
1221.	„ „	*Paris quadrifolia.*	14 May.	25 May.
1222.	*Æcidium Paridis.*	*Phalaris arundinacea.*	11 June.	1 July.

ÆCIDIOSPORÆ=*Æcidium Paridis.*

UREDOSPORÆ.—*Sori* parvi, utrimque foliorum superficiebus erumpentibus, obscure aurantiaci vel rubello-flavi: *sporæ* globosæ vel subglobosæ, coloris expertes, scite echinulatæ, contentis aurantiacis; magnitudine 30–35 μ.

TELEUTOSPORÆ.—*Sori* minuti, punctiformes vel lineares, aliquando confluentes, primo epidermide tectis, nigri: *sporæ* quoad figuram variabiles, subcuboidales, cylindricæ, subtriangulares; brunneæ, læves granulatæve; apicibus amplificatis, truncatis, planis, interdum oblique complanatis, raro cuspidatis, sessilibus, constrictione plerumque levissima, variabili; magnitudine 40–50 μ longit., 18–25 μ latit.

Uredospores.—Sori small, on both surfaces of the leaves, dark orange or reddish yellow: spores globose or subglobose, colourless, finely echinulate, with orange contents; 30–35 mk.

Teleutospores.—Sori minute, punctiform or linear, sometimes confluent, at first covered by the epidermis, black: spores variable in form, subcuboid, cylindrical, subtriangular; brown, smooth but granulated; summits thickened, truncate, flattened, sometimes obliquely, rarely pointed, sessile, constriction variable, generally very slight; 40–50 × 18–25 mk.

Æcidiospores on *Paris quadrifolia.*

Uredospores and teleutospores on *Phalaris arundinacea.*

Near Carlisle.

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* The numbers refer to the number of the experiments in my notebook of uredine cultures.—C. B. P.

Notes on Abnormal *Cypripedium* Flowers. By Miss M. F. Ewart, B.Sc. (Botanical Laboratory, University College, London). (Communicated by Prof. F. W. Oliver, F.L.S.)

[Read 16th June, 1892.]

(Plates I. & II.)

I. Cypripedium Sedeni.

The subject of the first of these notes is a flower of *Cypripedium Sedeni* (the well-known hybrid of *C. longifolium* and *C. Schlimii*), which occurred in the conservatory attached to the Botanical department at University College. The plant in question produced three flowers in the autumn of 1891; but it was only in the middle one of the three that any abnormality was observable.

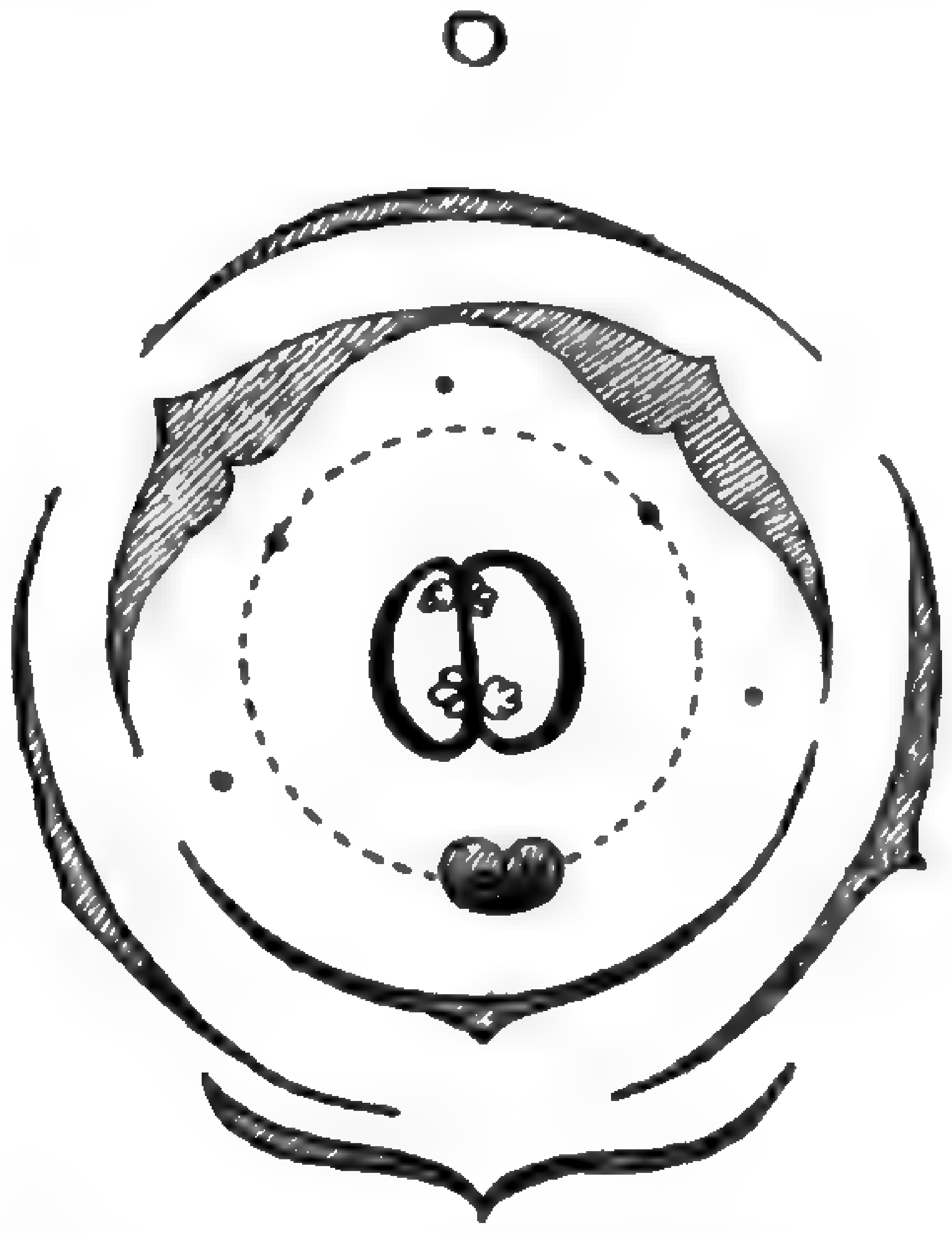
A superficial glance at the flower showed that two labellums were present (Pl. I. fig. 1); but, in addition to this, the andrœcium was affected, and the ovary exhibited a diminution of parts and also concrescence, down one side, with the axis on which the flower was inserted. The obliquity in position displayed by the unfolded flower (fig. 1) is referable probably to this fusion of ovary and axis. The flower shows five prominent perianth members, *i. e.* two sepals (s_2 and s_3), the two labellums (p_2 and p_3), and a third petal (p_1) on the opposite side of the flower. The relations of the third sepal will be discussed below. The column in the centre possesses a stigma (*st.*, fig. 4) and a single anther (*an.*). There is no staminode present nor any trace of the usual lateral stamens. The anther is on the side of the column directed towards the unpaired flat petal, the stigma towards the labellums. The plane which passes through the unpaired petal (p_1) and between the two labellums includes the anther and stigma. Below the labellums—that is to say, outside the flower—is a curious attached structure which, since it is the key to the situation, must be described.

The attached Growth.—This is shown in fig. 2 slightly twisted out of its natural position (which is behind the flower in this view), and in fig. 3 in greater detail. The structure exhibits a longitudinal slit above, which runs from the insertion of the flower to its apex. There is a similar longitudinal slit along the under surface, running the entire length; but it is somewhat obscured by the close overlapping of its edges. Dissection shows that these slits lead into an upper and lower chamber respectively (fig. 5), of which the lower is much the larger. A longitudinal partition, which is coextensive with the upper slit, forms the floor of the upper chamber and the roof of the lower one. A transverse section of the free part of this attached growth thus resembles the letter **H**. The upper chamber, which is empty, terminates at the point of insertion of the flower, and from this point downwards the growth is fused with the ovary of the flower (see fig. 5). The lower chamber (fig. 5) contains a flower-bud (b) on the side towards the ovary and a scale (s^1), which in its turn contains a flower-bud (b_1) and the rudiment of an axis (a). Finally, it should be noted that the apex (e, fig. 5) of the attached growth is bifid, a fact which gives support to the view that this growth is *double* in its nature, consisting of two excavated structures fused back to back, and opening the one by a slit above, the other by one below.

Interpretation of Parts.—The interpretation of the structures enumerated is as follows. It is so natural, that it is hardly liable to question. Examining fig. 2, it is seen that the expanded flower obviously arises in the axil of the bract b_1. Higher up we have the bract b_2 subtending a flower-bud. Between the points of insertion of b_1 and b_2 the axis is fused with the ovary of the first flower. Above the insertion of b_2 the axis—concealed from view in the "lower chamber"—becomes free, and bears (1) a bract b_3, the morphologically *upper* surface of which is fused in its proximal portion with the ovary of the expanded flower, whilst its distal part is similarly fused with the upper sepal of the expanded flower. The horizontal bar of the **H** is thus regarded as representing the fused portions of the bract b_3 and the upper sepal of the expanded first flower. This interpretation of the fused structures provides for the representation of the missing sepal, which is thus found in its proper place, though necessarily obscured.

Within the lower chamber the presence of certain structures has been noted: a flower-bud b, a bract s^1, an additional flower-bud b_1, and the rudiment of the axis a (fig. 5). These are all inserted in their right positions. The axis a is the continuation of the main axis, and we must regard the sheathing structure, which forms the lower part of the **H**, as a bract (b_3, fig. 2) borne by this axis. The flower-bud b is situated in its axil. On the opposite side (*i. e.* away from the expanded deformed flower) is the little bract s^1 (fig. 5), which in its turn subtends a tiny flower-bud b_1.

Passing on to the flower itself, the posterior or adaxial sepal has been recognized as the upper constituent of the **H**. The two other sepals lie in their proper positions, and there are three petalline structures alternating with them. Two of these are labelliform, and are inserted right and left of the reduced and modified sepal. The third petal is flat and ovate-lanceolate. This is in the position of the labellum of a normal *Cypripedium* flower. The two labellums similarly represent the two flat petals of a normal flower. This appears to be the simplest interpretation. The subjoined woodcut of the floral diagram of our flower shows the parts arranged so as to facilitate comparison with the diagram of a normal flower. In the andrœcium we find the two stamens of the outer whorl to be absent, whilst the anterior (and median) stamen of the inner whorl is developed. Finally, in the ovary the median posterior carpel is wanting. The ovary is thus bi-carpellary. Nevertheless the vascular bundle corresponding to the missing carpel can still be traced; so that we cannot regard this carpel as totally suppressed.



Floral diagram of *Cypripedium Sedeni* (abnormal specimen).

We have in support of the view that the labellum has been simplified and the lateral petals transformed into labella, the fact that the median stamen of the inner whorl, superposed to the median petal, is present and fertile; while in most cases when the median petal has the form of a labellum it is absent altogether. Masters observes * that the absence of this stamen seems to be correlated with the great development of the labellum, and in this case, when the median petal assumes a simple form, the anther is found to be well developed.

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* Journ. Linn. Soc., Bot. vol. xxii. p. 402.

Again, according to Masters, "Cases of partial irregular peloria in *Cypripedium* are not very uncommon; as, for instance, flowers in which the lateral petals (or one of them) assume the saccate form of the lip. This may occur without any increase in the number of parts."

Various instances are also mentioned in the paper by Masters already quoted in which the two lateral sepals were distinct, as here, and in which the median petal was intermediate between a labellum and an ordinary petal, or even became quite simple in form.

The modified flower here described is still zygomorphic, and the plane of symmetry still passes through the petal corresponding to the labellum in other forms and through the sepal (here much reduced) which is opposite to it.

II. MONSTROUS FLOWER OF CYPRIPEDIUM BOXALLI.

This flower presented a very strange appearance owing to the reduction and irregularity of its labellum. A sketch of the whole flower, as seen from in front, is given in Pl. I. fig. 7. The sepals and lateral petals were quite normal and well developed. The labellum, however, was very much twisted and contorted, and appeared to be much more reduced than was actually the case, in consequence of certain infoldings. The upper dorsal surface of the labellum had become attached to the lower part of the stigmatic surface (*b*, fig. 7), so that there were two small openings into the cavity of the labellum, one on either side of the adherent portion, instead of the usual single median aperture.

The column carried two fertile stamens, and the staminode was perfectly normal, except that it was slightly turned to the left away from the median vertical plane.

Only the upper part of the stigmatic surface was visible (*a*, fig. 7), since the upper fold of the labellum (*c*) was firmly adherent to the central portion of the stigma, and thus completely hid its lower portion from view.

In order to discover the nature of this attachment of the labellum to the stigma, I cut through the column vertically a little to the left of the median plane. Fig. 8 represents a view of the right-hand cut surface after the section. There was a large canal traversing the column longitudinally, which communicated above with the cavity of the labellum, and opened out under its adherent dorsal portion, *c*. This canal was subsequently traced downwards, and was found to be continuous below with the cavity of the ovary.

The upper dorsal part of the labellum, *c* (Pl. I. figs. 7, 8; Pl. II. fig. 9), below the point of its attachment to the stigma, *b*, was found to be continued down this canal as a folded flap or downgrowth, which hung quite freely in the abnormal passage, being only suspended at the point *b*, and nowhere else attached to the column.

The nature of the downgrowth of the labellum, enclosed in this canal, was best demonstrated by transverse sections taken at various levels. It was thin and membranous, and traversed by five longitudinal vascular strands. At the upper end it was folded lengthwise in three (fig. (1)), but towards its lower free extremity it became much narrower (fig. (3)) and terminated in a blunt point.

A general plan of a median vertical section of the flower is given in fig. 9, to show the relative position and relation of the labellum and its downgrowth to the column and other parts of the flower. The sepals and lateral petals are cut away, and the labellum is represented diagrammatically, the folds of the prolonged portion lying in the abnormal canal being omitted for the sake of clearness. It will be noticed that the ovarian cavity is not closed above, but is continued into the canal passing through the base of the flower and column, and so is in direct communication with the exterior. The small figures (1) .... (6) represent transverse sections through the flower, the respective levels from which they are taken being indicated in Pl. II. fig. 9 by corresponding numbers.

The note on *C. Sedeni* is communicated in view of the interest of the hybrid from its extreme liability to exhibit monstrous growths, so as to put on record a new variation till such time as it may be possible to deal with the hybrid in this respect exhaustively. That on *C. Boxalli* is of interest as an isolated instance in which an orchid ovary has, so to speak, swallowed a portion of the labellum of the same flower. The specimen was communicated by Dr. Maxwell T. Masters.

EXPLANATION OF PLATES I. & II.

Plate I.—*Cypripedium Sedeni.*

Fig. 1. The modified flower, from the front.

p_1. Median petal.

p_2, p_3. Lateral petals transformed into labella.

s_2, s_3. Lateral sepals (distinct).

Fig. 2. The modified flower, postero-lateral view.

s_1. Median sepal, here fused with a bract, b_3.

f, b_2. Floral bud and subtending bract, next youngest in age to the modified flower.

Other letters as in fig. 1.

Fig. 3. Ovary with attached bract, &c., from the front.

b. Bud seen through the lamina of the attached bract, which has been rendered semitransparent by spirit.

c.b. Outer border of bract formed by the overlapping edges of its lamina.

e. Bifid extremity formed by the apex of the bract and by the apex of the fused median sepal, s_1.

Fig. 4. Side view of column, after removal of perianth.

an. Anther.

st. Stigmatic surface.

Fig. 5. Semi-diagrammatic view of the ovary and attached bract, the anterior part of the lamina being partially removed in order to show the contents of the lower chamber *in situ*.

b. Flower-bud subtended by the attached bract.

o'. Its ovary cut across.

b_1. Younger flower-bud; s', its subtending bract.

a. Apex of the floral axis.

Fig. 6. Front view of the column, after removal of the two labella.

s_1. The median sepal, forming the upper chamber.

Fig. 7. View of complete flower, from the front.

a. Upper part of stigmatic surface.

b. Part of stigma to which the labellum adheres.

c. Adherent portion of labellum.

Fig. 8. Upper part of column, cut through vertically a little to the left of the middle line to show insertion of labellum.

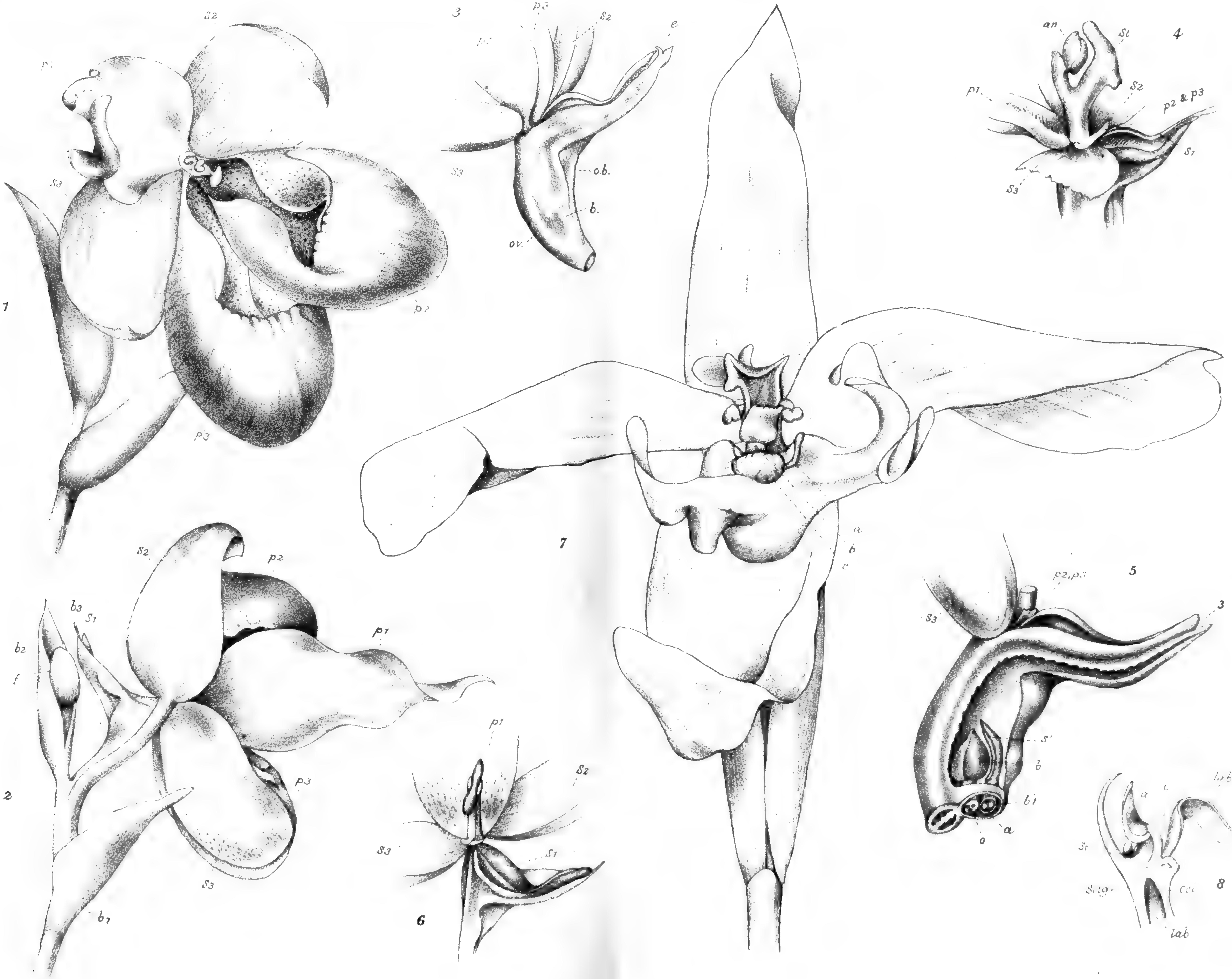
a, b, c, as in fig. 7. The downgrowth of the labellum is seen in the opened canal.

Plate II.—*Cypripedium Boxalli.*

Fig. 9. Diagrammatic view of flower, cut in half longitudinally. The sepals and lateral petals have been removed, and the labellum with its downgrowth is shown in outline.

b, c, as in figs. 7 and 8.

The figures (1) .... (6) represent transverse sections of the flower taken at the levels correspondingly numbered in fig. 9.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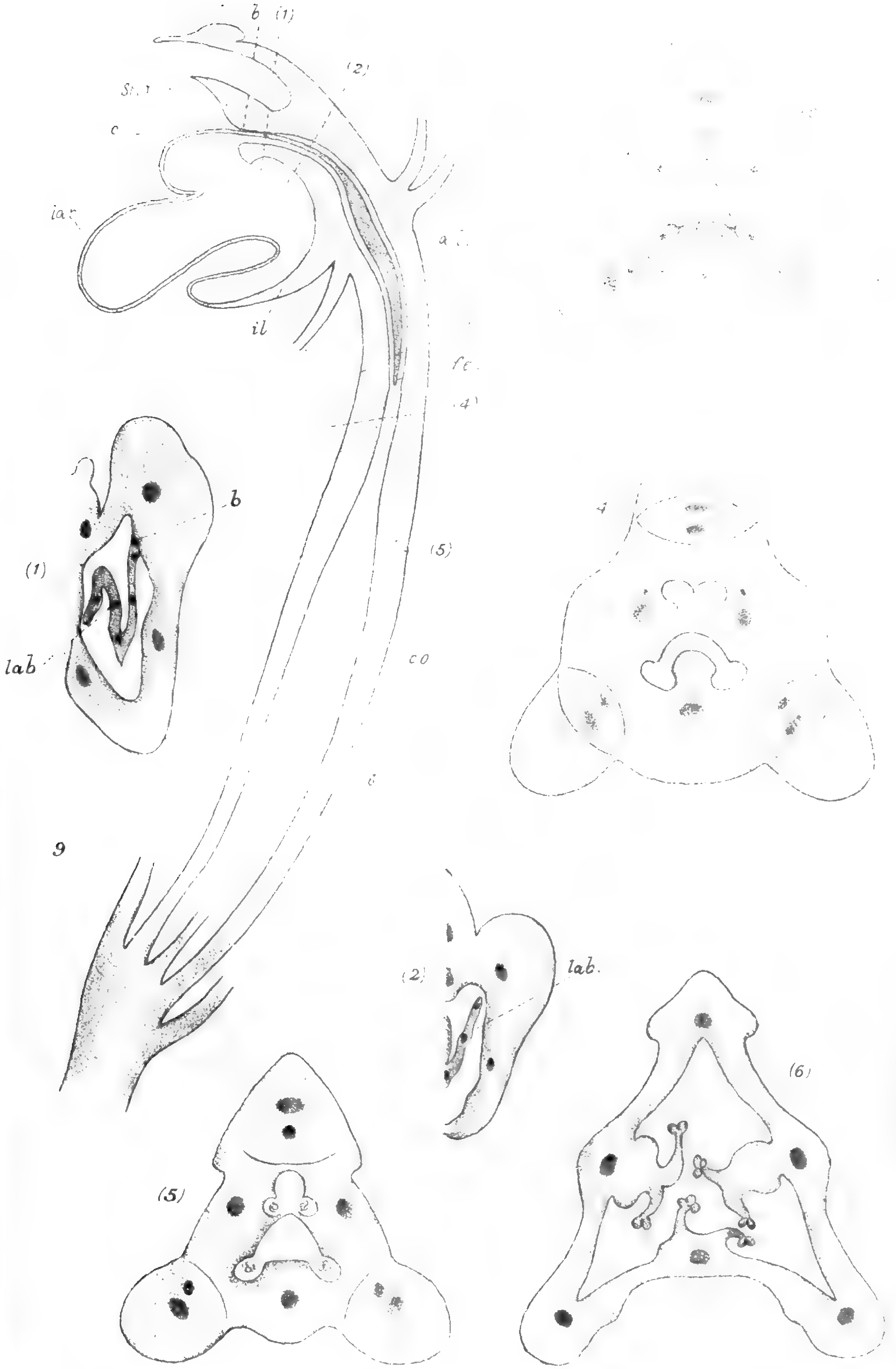
M.F.Ewart del.
A.R.Hammond lith.

Hanhart imp.

ABNORMAL CYPRIPEDIUM FLOWERS.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M.F. Ewart del.
A.R. Hammond lith.

Hanhart imp.

ABNORMAL CYPRIPEDIUM FLOWERS.

Contributions to the Natural History of the Flower.—No. I. Fertilization of *Claytonia*, *Phacelia*, and *Monarda*. By J. C. WILLIS, M.A., Frank Smart Student in Botany of Gonville and Caius College, Cambridge. (Communicated by FRANCIS DARWIN, F.R.S., F.L.S.)

[Read 16th February, 1893.]

(PLATE III.)

THIS paper contains the results of various observations, made during the summers of 1890–1–2, upon plants growing in the Botanic Gardens, Cambridge. The species not being in their native habitat, no attempt was made to form lists of their insect visitors; but as the author hopes shortly to visit the western United States, whence several of the plants here described have come, this and other defects may be remedied hereafter.

The plants described belong to three genera, viz. *Claytonia* (2 species), *Phacelia* (5), and *Monarda* (3).

CLAYTONIA.

Two species were examined, viz. *C. alsinoides*, Sims, and *C. sibirica*, Linn., and were found to agree so closely in all but a few minor points, that they may be described together. Meehan * and Robertson † have discussed the fertilization of *C. virginica*: the former has pointed out the way in which the sleep-movements cause autogamy, but has overlooked the protandry, which has been described by Robertson. Unfortunately the writer has not been able to consult the original paper, and the only abstract (in Just's "Jahresbericht") merely mentions the protandry, without describing the mechanism. Both the present species are protandrous, with occasional self-fertilization by the sleep-movements.

The inflorescence is a loose monochasial cyme, which straightens out in such a way as to keep the open flowers facing upwards or nearly so. The calyx consists of two large green persistent sepals, enclosing the claws of the five petals; the limb of each petal, which is bifid, spreads out over the calyx, almost at right angles (Pl. III. fig. 1). The total width of the fully opened corolla is about 8 mm. It is white in *C. alsinoides*, pinkish in *C. sibirica*, with (in both) glossy yellow patches at the angle of limb and claw, upon the upper surface. These possibly serve as honey-guides; in some lights they themselves look rather like drops of honey upon the petals. In *C. sibirica* a further honey-guide is formed by the veins of the petals, which are of a deeper red tinge than the tissue between. The stamens, five in number, are inserted upon the bases of the petals; each bears a nectary on its base, on the inner side. The honey is thus exposed to short-tongued insects, as there are no special adaptations for its protection from them. The anthers are large and versatile, but hang down in such a way that the opening is extrorse. The ovary is small and bears a style, ending in a trifid stigma, whose stigmatic papillæ are on the inner (upper) surfaces only (figs. 1 and 2).

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* "The Sleep of Plants as an Agent in Self-fertilisation," Proc. Acad. Nat. Sci. Philadelphia, 1876, p. 84.

† "Flowers and Insects. II.," Bot. Gazette, xiv. 1889, p. 172.

When the flower opens, the stamens stand up close round the style, bending outwards a little at their upper ends, with the anthers opening outwards. The style has its three stigmas closely folded in against one another (fig. 1). An insect alighting upon the corolla to obtain honey would, if large enough, be smeared with pollen upon its back. The stamens now begin to move slowly outwards and downwards, thus narrowing the space between them and the corolla, and rendering smaller insects liable to be smeared with pollen. At the same time the stigmas begin to separate and bend outwards. Finally the stamens lie completely prostrate upon the petals, and the stigmas are fully expanded and bent downwards, so as to be touched by the backs of insects visiting the flower (fig. 2).

The flower, if visited by insects of moderate size alighting on the petals, will probably be cross-fertilized. If an insect alight in the middle of the flower, there is less likelihood of any fertilization occurring. Self-fertilization sometimes occurs in the later stages by the agency of the sleep-movements. The petals in closing lift the stamens up around the stigmas, and although it is the backs of the anthers that are uppermost, and they are often empty at this stage, some pollen may often get upon the stigmas. That this method does not always work is seen from the fact that a large number of the flowers upon the plants examined set no seed. The only insect that was observed visiting the flower was a *Meligethes* sp.

If the flower is fertilized, the stalk bends down through 180° until the fruit is ripe, when it once again becomes erect, to facilitate the ejection of the seeds*.

The plants examined bore during the season a number of abnormal flowers, with 1, 2, 3, 4, or even all of the stamens aborted, and with smaller corollas. This is similar to the phenomenon observed in the gynodiœcious Labiatæ †, and it seems therefore possible that *Claytonia* may be gynodiœcious, or tending to become so. Experiments are being made upon this subject.

PHACELIA.

Five species of this well-known North-American genus were examined, belonging to three subgenera. Gray ‡ arranges the genus as follows:—

§ 1. EUPHACELIA.—*P. tanacetifolia*, Benth.
2. COSMANTHUS.
3. COSMANTHOIDES.
4. GYMNOBYTHUS.
5. WHITLAVIA, Gray.—*P. Whitlavia*, Gray, *P. Campanularia*, *P. Parryi*, Torr.
6. EUTOCA.—*P. divaricata*, Gray.
7. MICROGENETES.

The species examined belong therefore to three out of the seven subdivisions of the genus. It is hoped at some future time to study examples of the others. As the species to be here considered differ among themselves, they will be treated separately.

P. tanacetifolia.—The flowers § are borne in dense multiple cymes (three or four together), which unroll as they open, keeping the flowers facing upwards, just as occurs in the Boragineæ. The flowers are thus massed together, about 10 to 15 open flowers occurring at the top of each bundle of cymes. Their colour is a pale violet-heliotrope, and there is no perceptible scent, the attractiveness of the flowers to insects at a distance depending solely upon their conspicuousness.

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* Willis, "On the Distribution of the Seed in *Claytonia*," Annals of Bot. vi. 1892, p. 385.

† Willis, "Gynodiœcism in the Labiatæ" (preliminary papers), Proc. Camb. Phil. Soc. vii. 1892, p. 348, and viii. 1892, p. 17.

‡ 'Synoptical Flora of North America,' vol. ii. pt. i. p. 158.

§ Bot. Reg. t. 1696; Bot. Mag. t. 3703.

The flowers are borne on very short peduncles, arising from the main axis of the inflorescence, which is hispid, bearing also a few glandular hairs. The calyx, of five green sepals, is similarly hispid and glandular, so that it would be very difficult for creeping insects to reach the honey. The funnel-shaped or somewhat campanulate corolla is barely longer than the calyx; its depth is usually about 8 mm. and width at the mouth about the same. The stamens, five in number, are very long and project 8–10 mm. beyond the corolla, upon whose base they are inserted. The anthers are versatile and contain large quantities of bright yellow pollen (fig. 3). The corolla gives off, at its base, ten processes of a curious bat's-ear shape, one pair enveloping the lower end of each stamen (figs. 4 and 5, *pr.*). These project between the stamens to such a distance as almost to fill up the space between them and the style, as is seen in the cross section (fig. 4). They are attached to the corolla along a line close to the stamen, and their lower portions meet one another in the middle line above the stamen (fig. 5). These organs perhaps serve for the purpose of protecting the honey. The ovary is superior and bilocular, of flattened shape, ending in a style, which forks, at a height of about 2 mm. from the ovary, into two long branches, equal in length to the stamens. The extreme ends of these branches are stigmatic. Both ovary and style are provided with long hairs pointing upwards at an angle of about 45°. These are especially numerous on the end of the ovary, decreasing in number as we pass up the style, the last 6 mm. or so of which are glabrous. These hairs may very probably also assist in the protection of the honey, rendering it difficult of access to short-lipped insects.

Below the ovary the receptacle is flattened out into a disk, on the side of which the corolla is inserted, while its upper surface, projecting beyond the base of the ovary, secretes honey, which accumulates in the base of the flower, protected, apparently, by the various arrangements above described.

The stamens are bent inwards upon themselves in the bud, while the branches of the style are bent down outwards. When the bud opens the stamens straighten themselves out and stand nearly vertically, while the styles bend up just so far as to escape from the corolla and stand out almost horizontally over it (fig. 3). The anthers now dehisce, turning completely inside out in a manner to be described below, and present the whole of the pollen at once to visiting insects. The styles now bend slowly upwards, till at length they stand vertically and overtop the stamens (fig. 3, dotted lines); the second stage in the flower's history now begins. Finally the corolla withers, but does not usually drop off, remaining adherent to the ripening fruit for some time. The stigmas, so far as a microscopic examination shows, seem to be receptive all through the period of flowering, but are certainly somewhat better developed in the later stage.

The dichogamy of the flower gives it some chance of cross-fertilization, especially as it is largely visited (in Cambridge) for honey and pollen; but it seems probable that self-fertilization is more common, even when it is visited by insects. The flowers are closely packed together, and hence in the early stage the style of one flower overlaps into the next, and during the upward movement comes amongst the anthers of the other flower. Insects crawl over the whole mass of flowers, touching stamens and styles indiscriminately, and probably often knock pollen on to the stigmas from the surrounding anthers. The commonest visitors in Cambridge are honey-bees, various species of *Bombus*, and many Syrphidæ. The last-named seem usually only to collect pollen, the bees both pollen and honey. Every flower on the plants examined set a full complement of seed. An attempt was made to determine if seed were set when insects were excluded, but the plant became very unhealthy under the muslin net and its flowers did not open properly.

P. Campanularia.—The inflorescence is of the usual cymose type, but single instead of fascicled. The flowers also are widely separated, so that insects must fly from one to another, and are much larger that in the preceding species. The calyx and peduncle are hispid and glandular as in *P. tanacetifolia*. The corolla is campanulate and of a deep azure-blue colour. It increases considerably in size whilst open, as may be seen from the figures (figs. 7 and 8), which are drawn from photographs. In the earliest stage the total depth is about 15 mm., the total width about 18 mm, while the depth and width of the actual tube are each about 10 mm. In the latest stage these dimensions become about 20, 21, 15, 11 mm. respectively. There is no scent, and the attractiveness of the flower, as in all the species examined, rests upon its conspicuousness.

The tube is narrowed, especially towards the top, by five longitudinal furrows in the corolla, which form corresponding ridges inside, opposite to the stamens (fig. 9). These are coloured white and may perhaps act as honey-guides, beside narrowing the passage to the nectary. The stamens, five in number, are inserted upon the base of the corolla and project beyond it. The anthers are large and versatile, facing upwards. To the base of each stamen, on the inner side, is attached a scale, which projects laterally in its upper part (figs. 10 and 11). The projecting portions of the scales of adjacent stamens meet, and leave between them only a narrow opening to the chamber below, which contains the honey, secreted as usual by the disk below the ovary. The ovary is flattened and hairy, especially at the ends. The style is bifid with terminal stigmas, and hairy at the base. The hairs on the ovary and the base of the style fill up the space between themselves and the stamens, so that the only convenient access to the honey is between the bases of the stamens. No other protection from rain is afforded than that above described; the flower does not close, nor does it bend downwards. In its native country (California) this want of protection from rain may be no serious disadvantage, but in Cambridge the flowers were sometimes half filled with rain-water.

During the time that it is open, the flower usually faces in a southerly direction, at an angle of from 50° to 60° with the horizon (Cambridge, August). The stamens are bent downwards in the bud, the style straight, with its branches closely pressed together. The stamens straighten out when the flower opens, usually, however, becoming slightly curved upwards. The anthers dehisce very quickly and expose all their pollen at once. The flower (figs. 6 and 7) is now in its male stage, the style being still much shorter than the stamens, while microscopic examination of its stigmas discloses their unripeness, the papillæ not being as yet fully developed. The two branches of the style are more or less closely pressed against one another. It grows rapidly and in 24–36 hours is level with the stamens, finally overtopping them by 2–5 mm. The branches of the style also separate and the stigmas become fully developed. The female stage now begins (fig. 8) and closes with the fall of the corolla.

This flower is evidently much better adapted to secure cross-fertilization than the preceding species, while not so well fitted, perhaps, for self-fertilization. It is largely visited by bees (collecting honey and pollen) and Syrphidæ (for pollen). Only the bees are of service to the flower. The flies alight on the corolla and collect pollen from one anther at a time, without touching the stigmas. Bees alight sometimes on the corolla, touching styles and stamens with their backs as they reach for the honey, sometimes on the stamens, crushing them all up together with the styles, and probably causing self- as much as cross-fertilization. After visits of this second type, large quantities of pollen are usually found on the stigmas, if these are in their later stages.

Self-fertilization may occur as described above, or by pollen falling from the anthers as the styles grow, or on the fall of the corolla, which carries the stamens with it, and may rub the anthers over the stigmas in falling. In one case observed it occurred by the lengthening style growing right into an anther and so getting covered with pollen.

Of the flowers on plants left to themselves, about two-thirds only set seed. Another plant was grown under a muslin net, and only one flower out of 19 set seed. Very probably this one became self-fertilized in one of the accidental ways above referred to. Three flowers on another plant were fertilized in the earliest male stage, and then castrated and the corolla removed; only one of them set seed, and this may also have been due to subsequent accidental fertilization. Probably therefore, as the microscopic examination also shows, the stigmas are not receptive in the earliest stages.

The effect of covering with the muslin net was very striking as regarded the colour of the flowers; those which came out under its shade were of a much paler blue than those growing in the open sunlight.

P. Whitlavia (*Whitlavia grandiflora*, Harvey *).—This plant, belonging to the same subgenus as the last, closely resembles it. The campanulate corolla is somewhat larger, the total depth and total width being each about 24 to 27 mm. The tube is 10 mm. wide at the base, narrowing to 8 mm. in the throat. The colour is a dull purplish blue. There are no longitudinal furrows in the tube of the corolla, nor coloured honey-guides. It is covered with short downy hairs, and the size remains almost constant whilst the flower is open. The stamens stand closely round the style at the base of the flower and are glabrous; they bear the usual large versatile anthers. The appendages at the base of the stamens resemble those of *P. Campanularia*, but are hairy. Honey is secreted as usual. The ovary and style are hairy; the style is not, however, so deeply bifid as in the species last described.

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* Bot. Mag. t. 4813.

The whole mechanism very closely resembles that of *P. Campanularia*, except that the lobes of the style are closely pressed against one another in the early stage, and only separate when the style has grown up to the level of the anthers. The honey is perhaps better protected owing to the closeness of the stamens to the style at the base of the tube and the hairiness of the staminal appendages.

P. Parryi.—In general habit this species also resembles *P. Campanularia*, but the flowers are smaller. The calyx and peduncle are as usual hispid and glandular. The corolla is funnel-shaped, with expanded limb, and is provided on the outside with scattered glandular hairs, thus acting probably as a further protection against unbidden guests. Its total depth is about 13 mm. and width 23 mm., the width of the throat being about 9 mm. Age causes no appreciable increase in these measurements. The tube is contracted by five longitudinal furrows, but they are *alternate* with the stamens, not opposite to them as in *P. Campanularia*. They are coloured white, but are of no great depth in proportion to the diameter of the tube. The general colour of the corolla is a deep azure-blue. The stamens are long, projecting 5–10 mm. beyond the corolla, and bear large versatile anthers; they are thinly covered with long upward-pointing hairs, and bear glabrous basal appendages like those in *P. Campanularia*. Honey is secreted as usual. The ovary and style are hairy; the latter is more deeply bifid than in *P. Whitlavia*.

The mechanism is much the same as that of *P. Campanularia*. In the early stage the style is included in the corolla; its length, from the top of the ovary, is 10 mm. It lengthens afterwards to 19 mm. and overtops the stamens. Its branches are usually close together at first, though not actually adherent. The flower is visited, in Cambridge, principally by Apidæ and Syrphidæ, whose mode of action is the same as already described for *P. Campanularia*.

The peculiar mode of dehiscence of the anther in this genus was observed carefully in this species. The anther is oblong in shape, and versatile, facing upwards. Dehiscence begins near one end of each lobe, and the crack spreads rapidly along the entire length. Each lobe now turns itself gradually inside out, as one might turn a glove-finger, or as occurs in the explosive aril of *Oxalis*, until finally the whole anther looks like a ball of pollen, every grain being thus at one stroke extruded from the pollen-sacs. This is seen in figs. 6 and 7. A similar process occurs in *Gagea lutea*, as described by Kerner *.

P. divaricata.—This species resembles *P. tanacetifolia* more closely than the last three described. The inflorescence is a dense cyme, with small flowers. The plant is covered with long silky hairs, but is not glandular. The corolla, whose size remains constant, is about 10 mm. deep and 10 mm. wide, of a funnel-shape, and pale heliotrope in colour. The veins are somewhat more deeply tinged, and may possibly to some extent act as honey-guides. There are longitudinal furrows in the corolla opposite to the stamens, but these are not differently coloured from the rest. The stamens and style project only slightly beyond the corolla; both are hairy, the latter especially. Honey is secreted in the usual place, but the disk, instead of secreting it all over its surface, bears five well-marked swollen yellow nectaries, alternate with the stamens. These latter bear the usual appendages, which in this species are adnate also to the corolla, forming little pockets at the base of each stamen, between it and the corolla. They fit so closely together that there is no room between them for an insect to reach the honey, unless it forcibly separate them with its proboscis. The style is bifid as usual, but only to a depth of about 2 mm. (fig. 13).

The mechanism of the flower is much like that of the preceding species. The style, when the anthers open, is about 3–4 mm. below, and its lobes are closed against one another. It gradually comes up to the same level, and the lobes spread out at an angle of from 60° to 90° with one another. The position of the parts favours self-fertilization, while the dichogamy gives the chance of a cross. Insects crawl over the whole mass of flowers as in *P. tanacetifolia*, and probably very often effect autogamy. Every flower as a rule sets seed.

Summary: *Phacelia.*—The above described species present similar general features, but differ in detail. Two (*P. tanaceti-*

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* 'Pflanzenleben,' ii. p. 91.

folia and *P. divaricata*) have small, pale-coloured flowers, massed in dense cymes over which insects can crawl without flying from flower to flower. The other three species, all belonging to the same subgenus (*Whitlavia*), have large brightly coloured flowers, separated from one another upon the axis of the cyme, so that insects must fly from one to another. The former species are best adapted to, and seem often to obtain, self-fertilization; the latter are better adapted to a cross. All are dichogamous, but the larger-flowered species more so than the rest. In all the honey is secreted below the base of the ovary and protected by appendages, which in *P. tanacetifolia* are attached to the corolla, in *P. Campanularia*, *Whitlavia*, and *Parryi* to the stamens, in *P. divaricata* to both. The plants, especially the peduncles and calyces, are hairy to prevent creeping insects from ascending to the flowers.

The general mechanism resembles in many points that of *Hydrophyllum virginicum* as described by Loew[*], but in the latter the specialization of the corolline appendages has gone further, and they are turned into a tube for holding and protecting the honey. The series of species above described may also perhaps be compared with the series of species of *Geranium*, *Epilobium*, &c., as arranged by Müller[†], who shows how large and more conspicuous flowered species are best adapted for the cross, the inconspicuous for self-fertilization.

The above described species cover only three of the seven subgenera. It is hoped to publish at some future time observations on other species, as well as on some other genera of this hitherto almost untouched order. The flowers of *Nemophila* and *Hydrolea*, besides other species of *Phacelia* (subgenus *Cosmanthus*), have been studied during the past year, but the results are not yet complete enough for publication.

MONARDA.

The only published observations on the biology of this flower are those of Errera and Gevaert[‡], and of H. Müller[§], only the former paper dealing in any way with the floral mechanism. As the species considered by these authors is *M. ciliata*, it may not be out of place here to give a short account of the phenomena of fertilization in some other species.

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[*] "Blütenbiologische Beiträge, I.," Prings. Jahrb. xxii. 1891, p. 445.

[†] 'Fertilization of Flowers,' Eng. ed. 1883, pp. 155, 264, &c.

[‡] "Sur la structure et les modes de fécondation des fleurs," Bull. Soc. Roy. Bot. Belg. xvii. 1878, p. 38.

[§] *L. c.* p. 477.

M. didyma.—The flowers are massed in dense false whorls, like those of Mint. They are fairly large, with a brilliant red colour and strong aromatic odour. The bracts are reddish coloured on their upper surfaces, especially towards the base; they are large and surround the "whorl" of flowers, adding to its conspicuousness. The calyx-tube is long and narrow, ending in short teeth. The corolla projects a considerable distance beyond it, its total length being about 36 mm. The tube of the corolla is only about ·5 mm. in diameter near the base, and gradually widens above it. In the throat it widens to a diameter of about 4 mm. and then divides into an upper lip, continuing the line of the tube, and a lower lip, at right angles to it. The last 3 mm. or so of the lower lip are turned up at right angles to the rest (fig. 14). The outer surface of the corolla is covered with minute glandular hairs.

The two stamens are inserted upon the corolla, in the throat, upon the lower side; their filaments cross the throat, thus further narrowing its entrance, and run up under the upper lip; they project somewhat beyond it at the tip (fig. 14). Each bears a versatile anther, and the two are joined together laterally in a manner to be considered below (figs. 16 and 17). The anthers dehisce downwards. The style projects behind them; its anterior stigma is long, while the posterior, here as in most Labiatæ apparently of little use, is much shorter.

Honey is secreted, as in the rest of the order, by a gland at the base of the ovary It is fully protected from rain and from insects, other than those with tongues of 14 mm. or more in length, by the length (20 mm.) and narrowness of the corolla-tube.

The flower is markedly protandrous. At first the style (fig. 14) stands just behind the anthers, with its lower stigma parallel to itself. Later on it projects a little further and the stigma bends down (fig. 15). The stamens stand straight out at first and present the pollen to the back of an insect visitor alighting on the lower lip. The cohesion of the anthers perhaps serves to keep them in the most favourable position. Later on the filaments bend backwards and remove the anthers from their position, carrying them behind the style. If the anthers have been separated, by insects or otherwise, the filaments simply bend backwards, one on each side of the style, like those of *Teucrium.* If, however, as was usually the case in Cambridge, the anthers still cohere, the filaments have to go through more contortions to effect their object (fig. 15).

The flower appears to be adapted specially to long-tongued Lepidoptera, but none were observed visiting it in Cambridge (no night observations were made). Only a large insect would touch the stamens when standing on the lower lip. Various Syrphidæ were observed creeping over the flowers and eating pollen; but the only insect noticed attempting to reach the honey was a large yellow humble bee, which visited several flowers and made desperate efforts to obtain the nectar, though apparently without any success, its proboscis not being nearly long enough. Its back did not touch the stamens at all, though sometimes coming within a few millimetres.

The flower occasionally becomes self-fertilized during the movements of the stamens, &c., but very often this does not occur. Only a few of those examined set seed, and of these many had only one or two.

M. kalmiana and *M. fistulosa.*—These species have smaller flowers of a purplish colour. In the principal points of structure they resemble the preceding species, but the anthers are turned so as to stand with the long axes horizontal, as in *M. ciliata* (E. and G. *loc. cit.*). Kerner* has observed honey-bees visiting *M. fistulosa*, while avoiding the scarlet *M. didyma*, and suggests that the latter may be visited by humming-birds.

The Cohesion of the Anthers.—The manner in which the anthers of *Monarda* cohere was pointed out by Mr. F. Darwin, who suggested also that it should be worked out. In the young bud the epidermis of the anther is quite smooth (fig. 18), but after the bud has reached a length of about 5 mm. the cells of the epidermis swell out into papillæ of a conical shape with a rounded apex. This process occurs on those parts of the anthers which are contiguous to one another, but *not* only on the parts which are in contact. The wall of the papilla becomes slightly cuticularized, and is also transversely ridged on the surface of the cuticle. As the anthers are pressed together in the bud, the papillæ of the one become interlocked with those of the other, and thus the cohesion is effected.

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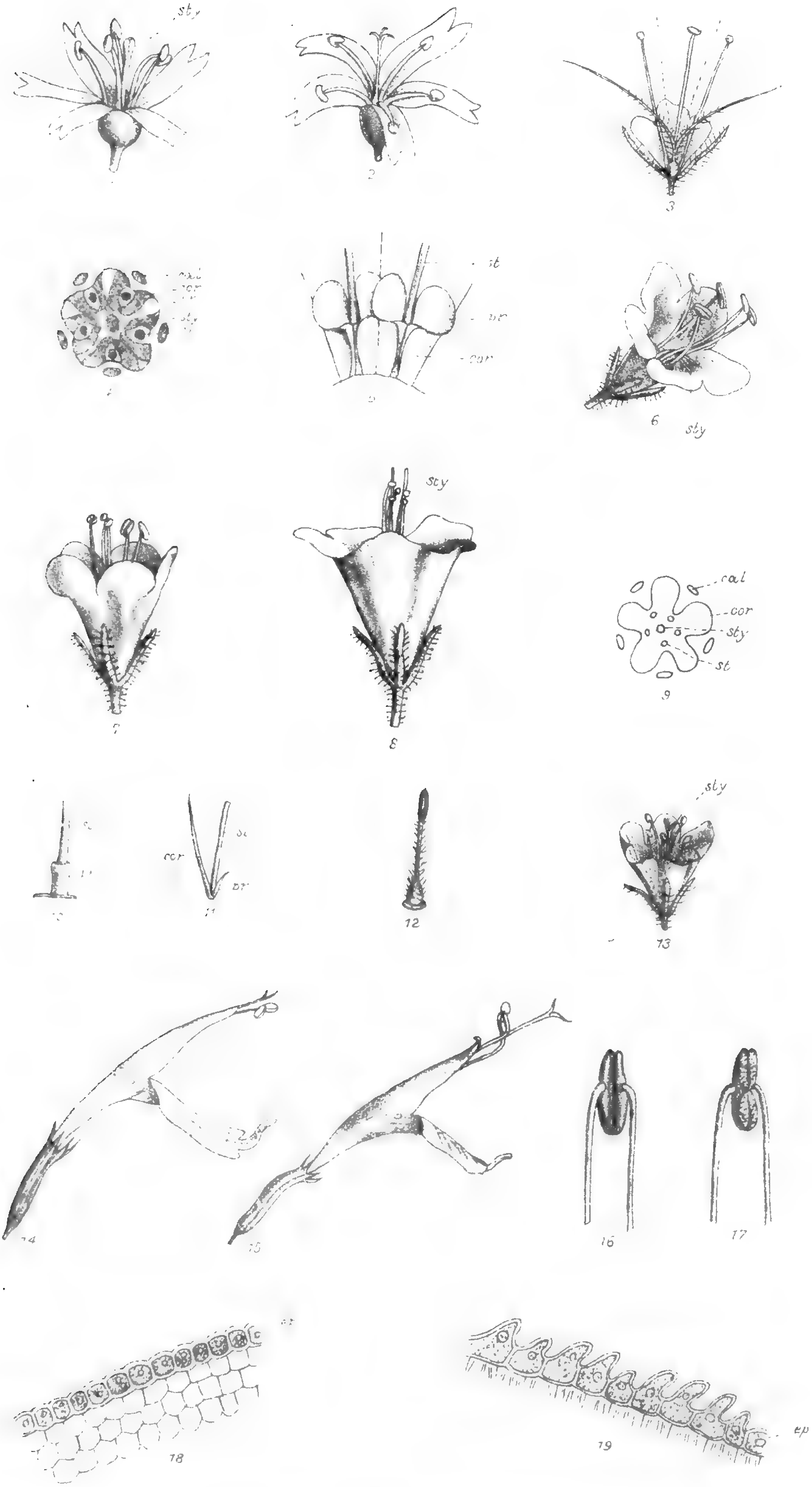
* 'Pflanzenleben,' ii. p. 191.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FERTILISATION OF CLAYTONIA, PHACELIA & MONARDA.

It is hoped to follow this paper with a second, containing observations on other Hydrophylleæ, besides *Calandrinia*, *Cleome*, *Ziziphora* (the anthers cohere like those of *Monarda*), *Calliprora*, and other flowers. These have all been studied in 1891–2, but the observations are still incomplete. In conclusion, the author desires to express his sense of obligation to Mr. Francis Darwin for his ever-ready advice and criticism, and to Mr. I. H. Burkill, who kindly verified the species of *Phacelia*.

EXPLANATION OF PLATE III.

Fig. 1. *Claytonia alsinoides.* Flower in early stage. × 3½.
2. Do. Flower in late (female) stage. × 3½.
3. *Phacelia tanacetifolia.* Flower, with half of calyx and corolla &c. removed, in early stage. The dotted lines represent the position of the styles in the later stage. Nat. size.
4. Do. Transv. sect. of flower near the base, passing through the coralline appendages (shaded). × 4.
5. Do. Portion of base of corolla, seen from inside, with two stamens, showing the peculiar appendages of the corolla. × 4.
6. *P. Campanularia.* Flower in early (male) stage before dehiscence of the anthers; from a photograph. ⅚ nat. size.
7. Do. Flower in early stage, seen from side, with three anthers dehisced; from a photograph. ⅚ nat. size.
8. Do. Flower in late stage, seen from side; from a photograph. ⅚ nat. size.
9. Do. Transv. section of corolla &c., taken at level of middle of calyx-lobes, showing the furrows. Nat. size.
10. Do. Stamen-base seen from within. × 2.
11. Do. Stamen-base seen from side. × 2.
12. Do. Ovary and style. Nat. size.
13. *P. divaricata.* Flower in late stage. Nat. size.
14. *Monarda didyma.* Flower in early stage. Nat. size.
15. Do. Flower in late stage: the corolla has become bent at the point of meeting the calyx-tube, as commonly happens in this flower. Nat. size.
16 Do. Anthers seen from behind. × 4.
17. Do. Anthers in front view. × 4.
18. *M. fistulosa.* Epidermis of anther from a bud 5 mm. high. × 240.
19. Do. Epidermis, bud 10 mm. high. ×240.

cal.=calyx; *cor.*=corolla; *ep.*=epidermis; *pr.*=process of corolla or stamens; *st.*=stamens; *sty.*=style.

On the Botanical Results of the Sierra Leone Boundary Commission. By G. F. Scott Elliot, M.A., F.L.S.

[Read 16th March, 1893.]

Introduction.

The object of the Sierra Leone Boundary Commission (to which I was attached as botanist) was to trace the boundary of the French and English spheres of influence at Sierra Leone. During the expedition we passed over about 700 miles, without, however, being ever more than 300 miles from the coast or reaching a greater height than 3600 feet *.

At about 2500 feet there were signs of a different flora, such as the presence of certain Composites, bulbous plants, and some epiphytic orchids which do not, I think, occur below this level; but these signs were quite as distinct on the Sugarloaf Mountain at Freetown as on the broad grassy table-like watershed which separates the Niger from those rivers (Scarcies, Rokelle) which flow direct to the West Coast. As a whole it is a forest flora of a humid evergreen type, and perhaps chiefly characterized by the abundance of trees and climbers and by a large proportion having thick coriaceous, often pinnate leaves and usually inconspicuous flowers.

The results have been, to me at least, most disappointing. I brought home 2200 numbers which have yielded about 1170 species, amongst which there seem to be two new genera and about 50 or 60 new or unnamed species, most of which are here described. This is partly due to the short time at my disposal (as we were only 5½ months in the country, of which 30 days were rendered blank through fever and weakness), partly to the difficulty of drying plants in a very humid climate and when constantly travelling, but perhaps chiefly to the extremely thorough way in which the flora has been already studied.

Afzelius was several years at Freetown; Adanson 6 years in Senegambia, Leprieur and Perrottet 5 years, Heudelot 4 years; Mr. G. Mann spent 4 years on the coast, Isert and Thonning 3 years, Beauvois and also Barter 2 years; and Baikie and Vogel made important collections besides those mentioned. Many others have also worked upon this flora †.

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* According to rough calculation by Major Kenney.

† For example, G. Don, Brass, Burton, Griffon du Bellay, Daniell, Irving, Matthews, Purdie, Sieber, Smeathmann, Ch. Smith, Soyaux, Miss Turner, Whitfield, Dr. Lester Thomson, C. Thomson, Pogge, H. H. Johnstone, Preuss, and others.

In naming this Collection I have had the kindest and most unremitting assistance from Professor D. Oliver, Mr. C. B. Clarke, Mr. Baker, and all his assistants at Kew, as also from Mr. Carruthers's staff at the British Museum. I have given new and doubtful forms at any rate to those who are authorities on particular orders or are at present working upon them; and have specially to thank those who have taken the following groups entirely off my hands:—

Amaryllids, Lilies, and Iridaceæ, by Mr. J. G. Baker.
Cyperaceæ, Commelinaceæ, Mr. C. B. Clarke.
Orchids, Mr. R. A. Rolfe.
Solanaceæ and Cryptogams, Mr. C. H. Wright.
Fungi, Mr. G. Massee.
Apocynaceæ, Dr. O. Stapf.

The description of new and doubtful forms only in the following orders have been left to those mentioned:—

Malvaceæ, Mr. E. G. Baker; Gramineæ, Mr. A. B. Rendle; Scrophulariaceæ (except one *Dopatrium*), Mr. W. B. Hemsley; Ebenaceæ, Mr. W. P. Hiern; Acanthaceæ, Mr. Rolfe; Aroids, Mr. N. E. Brown; Melastomaceæ, Professor Cogniaux; Aristolochia, Dr. Masters; Labiatæ and other Corollifloræ, Mr. J. G. Baker.

I have to thank these gentlemen for the descriptions which they have kindly given me for insertion in this paper, which I have been careful not to alter in any way. The rest of the naming and description has been done by myself, and I have specially to acknowledge my obligation to Professor D. Oliver for his most kind assistance, and also to Mr. N. E. Brown, whose carefulness and 20 years' experience of Herbarium work have been most valuable to me.

I am also indebted to Miss A. Lorrain Smith for the very careful anatomical study which she has made for me of a plant without flowers which has greatly puzzled every systematic botanist to whom it has been shown; anatomical characters alone show that it probably belongs to Gentianaceæ or Melastomaceæ, and after carefully examining both orders it seems to me that it may be a new genus of the latter near *Lavoisiera*. Miss Smith's observations will probably be given in another memoir.

The first set of the plants is at Kew, the second at the British Museum, the third has gone to Berlin, the fourth to Harvard, the fifth to Calcutta, and the sixth to Paris; and I have to thank Mr. Carruthers for saving me much trouble and also expense in forwarding some of these. A small set of Pharmaceutical specimens are now in the possession of the Pharmaceutical Society.

Of these 1170 species the proportion of four natural orders is given below as contrasted with that of the Niger flora, Richard's Abyssinian, Kotschy's Nubian, and Mr. Mann's floras, the latter having 237 species which occur above 5000 feet in the Cameroons.

	This Collection.	Niger Flora.	Richard, Abyss.	Kotschy, Nubia.	Mann, Cameroons.
	per cent.	per cent.	per cent.	per cent.	per cent.
Leguminosæ	10	14	11	15	3
Rubiaceæ	11	9	2	—	—
Compositæ...............	4	5	11	7	12
Gramineæ	2	8	12	12	13

The other largest orders in my collection are:—Euphorbiaceæ 57 species, Orchids 32, Anonaceæ 25, Apocynaceæ 21, Cyperaceæ 22, Scrophulariaceæ 18, Scitamineæ 17, Loganiaceæ 16, and Aroids 14 species respectively.

I found in matching my specimens that those of Barter, Baikie, and Vogel from the Niger expedition were of the most use (after those from Freetown itself); C. Smith's Congo plants seemed also for the most part almost identical; and I have also found many of Welwitsch's Angola species amongst mine. There is a general idea that the Flora of East and West Tropical Africa is largely identical, but my experience in naming my specimens is very strongly against this*; it is very rarely indeed that I have found any of my species occurring along the East Coast or anywhere East of a line drawn from the Albert Nyanza along the West shore of Tanganyika to the Tropic of Capricorn; and I was so strongly impressed by this, that I have looked a little further into the question. It seems to me that if we take all West Tropical Africa from Senegambia to Angola, and the whole drainage-area of the Niger and Congo, and if we were to exclude all the higher land above 3000 feet in altitude, we should have an extremely natural botanical region. The Rubiaceæ—which have been so well worked out by Mr. Hiern in the 'Flora of Tropical Africa,' which include the Welwitschian specimens and Congo plants in the British Museum—seemed to me to be a good order in which to test this theory. I find that of the 498 species enumerated:—

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* Sir Joseph Hooker pointed out the similarity of Mann's *high altitude* plants of the Cameroons with those of Abyssinia, and this seems to have been applied by others to the whole flora: *cf.* Journal Linnean Society, vols. vi. (1862) pp. 1–4, & vii. (1864) pp. 171–181.

250 are confined to West Tropical Africa;
30 in West Tropical Africa, which also occur in Darfur, Fazokel, or Schweinfurth's collections near the watershed of the Congo in Monbuttuland, Niamniam, &c.;
76 are confined to Nileland and Abyssinia;
58 to Mozambique, Zanzibar, and Zambesi;
16 range from Abyssinia to Angola;
3 Mozambique to Angola;
20 confined to Angola; and
18 are common to East and West Tropical Africa, which small number includes common widely diffused species.

That is 250+30, or 56·2 per cent. belong entirely to this proposed region, 40·2 per cent. to the remainder of Tropical Africa, and 3·6 per cent. do not suit this theory.

Other points in favour of this view are:—

1. It agrees very closely with one of Wallace's distribution areas (2, Soudan).
2. It is really an area bounded by water-partings.
3. It is distinguished by the rainy season being almost invariably between April and November, while on the Eastern side it is almost invariably between October and May *.
4. It is an evergreen-forest region characterized by great humidity, and is separated from similar districts on the East Coast by a series of grassy upland plateaux and mountains which seem to be approximately continuous from Abyssinia to Nyassaland and Angola.

As Mr. C. B. Clarke has pointed out for similar regions of

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* The rain occurs in Senegambia, Sierra Leone, and Kordofan as above; Unyamwesi, Tanganyika, and Tette (our winter) as above; Zanzibar has a double season, Oct.–Dec. and Mar.–May; while the Gaboon is exceptional with rain also from Oct. to May, and Abyssinia has summer rains.

Wallace, this would be almost impossible to tabulate upon (Phil. Trans. vol. 183. p. 371), but his subdivision into Africa North and South of the Equator would separate both the Congo and Angola entirely from the Niger, which seems unfortunate.

As to the origin of this Niger-Congo flora, we can at present only speculate. I have been able to see something of the Canary Island flora and of Algiers, and there does not seem any connexion with this Niger-Congo flora. The Sahara flora, known to me from Tripoli and Egypt, and the Upper Nile flora from Wady Halfa also show no affinity with it, neither does anything I have seen in Cape Colony, Transvaal, or Natal remind me of this district. On the other hand, Angola falls partly within it and there seems strong affinity with the Abyssinia to Nyassa flora, shown, however, chiefly by genera not species. Hence it seems to me possible that the ancestors of these plants crossed into the Congo valley from the East, and were perhaps originally connected with India when the Nubian sandstones were deposited, *i. e.* before the arid character of the Sahara and Arabia was established. It does not seem at all likely that they came from the North, as the high altitude plants seem almost certainly to have done.

In this connexion some have been inclined to suppose communication by islands from the West Indies to West Africa. I have been able to add a few more species common to both these regions (*Symmeria paniculata*, *Hyptis*, 2 species, *Xyris laxiflorus*, and *Pycreus* sp.), but we must remember the constant traffic which has taken place between West Africa and the West Indian islands almost since the discovery of the latter; both rice and maize, and possibly manioc, have been imported constantly for growing, and also tobacco. The ancestors of the present population of Freetown were also brought from America and carried with them, as is very obvious at Freetown, fruit-trees and probably medicinal plants, so that there has been great opportunity for accidental introductions; while the drift of the ocean currents seem to be mainly from Africa to America. On the other hand, the occurrence of such genera as *Bertiera* and *Sabicea* with many endemic species cannot be explained in this way, and a full knowledge of both Indian and American floras would be required before finally settling the question.

DESCRIPTIONS OF NEW SPECIES AND VARIETIES.

ANONACEÆ.

ANONA LATIFOLIA, sp. nov.

Arbor ramis rugosis rubris, junioribus petiolisque brunneo-velutinis; foliis amplis coriaceis obovato-oblongis vel ellipticis acuminatis acutis basi rotundatis vel subcordatis, superne sine costâ venisque brunneo-pilosis glaberrimis, inferne pilis stellatis conspersis; venis venulisque prominulis, venis 15–18-jugis; limbo 20–25 cm. long. et 13 cm. lat.; petiolis brevibus crebris 6–8 mm.

Flores virides, pedunculis solitariis 2 cm. cum bracteis sepalisque dense brunneo-tomentosis; bracteis parvis. Sepalis membranaceis ovatis obtusis connatis; petalis coriaceis dorso dense puberulis interne subglabris margine revoluto, exterioribus late ovatis obtusis 11 mm. × 13 mm., interioribus obovatis basi contractis 16 mm. × 10 mm.

Stamina numerosa, obpyramidales lateraliter dehiscentes, superne expansa truncataque. Carpellis connatis; stigmate hirsuto applanato.

A. Mannii affinis sed petalis 6, floribus solitariis, foliis circa 5 uncias latis.

Near Kafogo in Limba Country, April 6, no. 5617. Flowers green, near Berria Falaba, March 30, no. 5421.

UVARIA SOFA, sp. nov.

Arbor 20-pedalis, ramis corrugatis dense pilis stellatis ferrugineis aureisve hirsutis; foliis membranaceis oblongis vel ovatis plurime subacutis basi rotundatis vel subcordatis, supra sparse inferne dense stellato-pilosis; venis circa 10-jugis; foliis 6–10 cm. long. et 3–5 cm. lat.; petiolo 4 mm.; racemis congestis oppositifoliis 1–3-floris 2–3 cm. longis; bracteis oblongis parvis; sepalis membranaceis ovatis valvatis reticulato-venosis, cupulam maturitate ruptam formantibus, externe dense hirsutis, 12 mm. long. et 9 mm. lat.; petalis nigris subcarnosis oblongis vel ovatis dorso sparse hirsutis margine varie undulato, 4–5 cm. long. et 5–10 mm. lat.

Stamina numerosa circa 2 mm. extrorsa; connectivo triangulare; carpellis numerosis hirsutis, stigmate cylindrico carnoso truncato, ovulis circa 10.

On the banks of the Niger, Farana, 10° N. lat., about 3600 ft. alt., March 26, no. 5370.

UVARIA AFZELII, sp. nov.

Frutex ramis rubris corrugatis, juventute dense pilis aureo-brunneis hirsutis; foliis oblongis vel oblongo-obovatis obtusis vel obtuse acuminatis, margine revoluto basi rotundatis, superne sparse pilis albis plurime simplicibus conspersis, inferne supra venas cum venulis prominentes densiuscule pilis aureis plurime stellatis obtectis; facie etiam sparsiuscule hirsuto; venis circa 12-jugis; foliis 9–14 cm. long. et 3·5–7 cm. lat.; petiolo hirsuto 3–4 mm.; pedunculi solitarii oppositifolii cum sepalis petalisque dense aureo-velutini, 2–3 cm.; floribus 3–4 cm. diam.; sepalis ovatis acutis, 10–15 mm. long. et 5–11 mm. lat.; petalis 18 mm. long. et 10 mm. lat., exterioribus late ovatis, interioribus obovatis cuneatis ad basin interne albo-pilosis.

Stamina numerosa subsessilia, circa 2 mm. long., lateraliter dehiscentes; connectivo triangulare; carpellis hirsutis ovulis circa 6 campylotropis; stigmate carnoso triquetro.

Fructus bilobus, longe stipitatus dense albo-velutinus, 2 cm. long. et 15 mm. lat. et diam.; stipite 3–4 cm.

Between Kahreni and Port Lokko in Limba Country (in flower), April, no. 5812; near Mofari, on Scarcies River (in fruit), Jan., no. 4412.

Also Afzelius no. 4 in Herb. Mus. Brit., *Sierra Leone.*

CLATHROSPERMUM VOGELII, *Planch.*

Professor Baillon has already pointed out (Adansonia, viii. p. 320) that this name contains more than one species in the Kew Herbarium and in the 'Flora of Tropical Africa.' The following Key may therefore be of use in discriminating the species.

1. C. VOGELII, *Planch.*

Leaves rounded at base; outer petals broadly ovate, inner oblong; stamens few, similar and dehiscing laterally. Hooker, Flor. Nigr. p. 208, tab. 10.

On the Quarra Sterling, *Vogel, no.* 203! *Barter, no.* 1221!

2. C. BAILLONII, *S. Ell.*—Popowia Mannii, *Baill. l. c.*

Leaves rounded at base; outer petals almost orbicular, inner

spathulate, narrowed at base; stamens 21–25, of which only 9 are fertile.

Bagroo River, *Mann*, 1861.

3. C. HEUDELOTII, *S. Ell.*—Popowia Heudelotii, *Baill. l. c.*

Leaves cuneate at base; petals similar, obovate, narrowed at base; stamens 9, *extrorse*, with the 4 loculi parallel and touching.

Sierra Leone, 8/5/57, *Barter*! Niger, 1857, *Barter*! In depressis fertilibus ad Karkandy, Senegambia, ubi anno 1837, leg. *Heudelot, no.* 878. Madina Limba, April 11, 1892, *Scott Elliot, no.* 5656.

4. C. MANNII, *Oliver, Fl. Trop. Afr.* i. p. 25.

Flowers unisexual; inner petals minute; stamens 7.

Mount John, river Konqui, Aug. 1862, *Mann, no.* 1782! Gaboon River, July 1861, lat. 1° N., *Mann, no.* 960! Old Calabar, *Thomson.*

(The only other species known to me are *C. biovulatum*, S. Moore, from East Africa; and an undescribed form, *Schweinfurth, nos.* 204 & 1931.)

ARTABOTRYS VELUTINUS, sp. nov.

Folia 3–6 uncias longa et 1–2 uncias lata; pedunculis circa 9-floris; petalis cylindricis basi concavis (*cf. Oliver, Fl. Trop. Afr.* i. p. 28).

Planta scandens, ramis teretibus nigris striatis, juventute dense pilis aureo-brunneis conspersis; foliis coriaceis oblanceolatis vel ellipticis obtusis margine incrassato subrevoluto basi angustatis, inferne marginibus, costa, venisque pilosis, cæteris glabris; venis utrinque prominulis circa 8-jugis; foliis 7–13 cm. long. et 3–4 cm. lat.; petiolis brevibus pilosis 3–6 mm.; pedunculis brevibus curvatis demum uncam validam scandentem formantibus, sæpius 9-floris quarum 3 mediales et 6 terminales sunt; bracteis parvis linearibus 2–4 mm.; pedicellis 6–9 mm.; sepalis 3 ovato-triangularibus (3 mm. long. et lat.); petalis cylindricis ad basin concavis orbicularibus æqualibus dense pilis aureis velutinis 10–12 mm. longis obtectis; staminibus 20 obpyramidalibus lateraliter dehiscentibus; carpellis 7–9; stigmate carnoso ligulato, 2 mm.; ovulis 2 erectis.

A climber in riverside woods on alluvium 5 miles east of Musaia, near Falaba, March 10, no. 5137.

MONODORA BOREALIS, sp. nov.

Petala exteriores, 1½ uncias longa, valde undulata; petalis interioribus orbicularibus sine dentibus auriculisve (*cf.* Oliver, Fl. Trop. Afr. *l. c.*).

Arbor glaber, ramis griseis glaucis juventute nigris; foliis membranaceis oblongo-ellipticis vel obovatis (*M. tenuifoliæ* potius *M. brevipedi* similaribus) vix acuminatis margine revoluto basi angustatis, 14–28 cm. long. et 5–10 cm. lat.; venis circa 12-jugis cum venulis utrinque prominulis; petiolis crebris rugosis 5–8 mm.; flores magni solitarii; pedunculis 4 cm.; bracteis late ovatis haud foliosis 5 mm.; sepalis ovatis obtusis 8–10 mm. long. et 6 mm. lat.; petalis exterioribus 4 cm. long. circa 5 mm.–1 cm. lat., margine varie undulato vel crispato; interioribus orbicularibus basi contractis margine interneque pilis longis (2 mm.) conspersis circa 2 cm. diam.; staminibus numerosis cuneatis lateraliter dehiscentibus, connectivo carnoso depresso; ovario mammæformi.

On the way to Kukuna, Scarcies River, Jan. 7, no. 4716.

MENISPERMACEÆ.

SYNCLISIA LEONENSIS, sp. nov.

Frutex subscandens, cortice cinereo vel griseo striato; ramulis gracilibus hirsutis; foliis membranaceis lanceolatis acuminatis acutis ad basin gradatim attenuatis glabris vel inferne costis obscure hirsutis, subquinquenerviis; nervuris a costa circa 3-jugis; foliis 7–13 cm. long. et 15–40 mm. lat.; petiolis infra laminam crassis juventute hirsutis supra canaliculatis 10–15 mm. long.

Racemi caulini dense hirsuti 8–10 cm.; pedunculis sæpius 20–30, 10–15 mm., in capitulum 6-florem terminatis; bracteis parvis margine ciliatis; bracteolis 3 minutis 2 mm. diam. suborbicularibus rugosis; sepalis exterioribus 3 ovatis ciliatis 2 mm., interioribus 3 ligulatis vel oblongis conjunctis corollamque simulantibus 6 mm. long. et vix 2 mm. lat.; petalis 6 membranaceis spathulatis staminodia simulantibus vix 2 mm. long.

Stamina 6; filamentis crebris; antheris lateraliter dehiscentibus.

Flowers yellow, Kahreni Limba Country, no. 5627.

BIXINEÆ.

COCHLOSPERMUM NILOTICUM, *Oliver.*

It is only with some hesitation that I have identified this plant with those at the Kew Herbarium collected by Petherick on the Upper Nile and by Schweinfurth. It may very well be a new species, and is almost certainly a new variety.

Near Moria, on Upper Scarcies River, Feb. 13, no. 4793.

POLYGALACEÆ.

SECURIDACA LONGEPEDUNCULATA, *Fres.*, var. PARKII, *S. Elliot*; foliis oblongis ellipticis obtusis ovatisve basi angustatis, subtus glaucis; pedicellis 15–27 mm.; petalis lateralibus obovatis cuneatis 3–6 mm.

Gambia River, *Mungo Park*! A shrub with red flowers some 4 feet high, on bare rather dry ground near Falaba, March 12, nos. 5140 & 5149.

I should have described this as a new species were it not for the very wide distribution according to Professor Oliver, who includes under this name two Abyssinian forms described as different species by Hochstetter, a Zambesi form specifically described by Klotzsch, as well as a Niger plant, *Barter, no.* 1198.

DIPTEROCARPEÆ.

ANCISTROCLADUS BARTERI, sp. nov.

Frutex uncis validis spiralibus scandens; cortice rubro-glauco; foliis coriaceis glabris oblanceolatis vel obovatis obtusis vel acutis etiam subacuminatis ad basin angustatis, margine valde revoluto (haud more *A. guineensis* involuto); venis venulisque utrinque prominulis; foliis 17–30 cm. long. et 7–10 cm. lat.; petiolo subnullo.

Paniculi dichotomi 18 cm. longi et 12 cm. lati; ramulis versus apicem, flores 7–10 spicatas ferentibus; pedicellis crebris sub flore articulatis circa 2 mm.; bracteis ovatis obtusis circa 2 mm.; calycis lobis inæqualibus ovatis vel oblongis obtusis glabris, in flore circa 4 mm. long. et 2 mm. lat., in fructu 8 mm. longis; petalis oblongis orbicularibus obtusis 6 mm. long. et 5 mm. lat.

Stamina 9–10 basi per paria ad petalam conjuncta; antheris inæqualibus; connectivo haud producto; stylis 3; stigmate capitato; fructu obpyramidale 5-angulare, costis incrassatis, sine

calycis lobis 15 mm. long. et 15 mm. lat.; seminis cotyledonis plicatis contortuplicatis.

On Mount Gonkwi, Duunia Talla Hills, Feb. 16, no. 4860; an undershrub in forest by Kora River, Feb. 13, no. 4797.

Also shrub scandent, 14 feet, supporting itself by spines, Onitscha, Niger Expedition, *Barter, no.* 1699!

MALVACEÆ.

KOSTELETZKYA FLAVA, *E. G. Baker*, sp. nov.

Perennis, caule erecto stellato-scabrido inferne terete superne applanato; foliis breviter petiolatis anguste oblongis vel anguste oblanceolatis apice acutis basi cuneatis margine præcipue versus apicem serratis trinerviis utrinque stellato-pubescentibus; pedunculis solitariis unifloris strictis teretibus quam folia brevioribus vel subæquantibus, versus apicem articulatis, bracteolis linearibus pubescentibus calyce brevioribus; sepalis lanceolatis acutis; petalis (in siccitate flavis) quam calyx brevioribus; capsulis hispidis pentagonis ad angulas salientes pubescentibus 5-cellulis, 5-spermis, spermis brunneis.

Stem 1½ feet high or more; leaves 1–2¼ inches long, about ¼ inch broad; petioles ¼ inch.

Differs from *K. adoensis*, Hochst., by its narrow leaves and unbranched peduncles.

Rather wet alluvial by river at Erimakuna, alt. c. 3000 feet, in Niger drainage area, March, no. 5256.

Probably the following specimen of Welwitsch no. 4900, "am Cuanza Sasamanda, Pungo Andongo, Feb. 1857," is a stouter form of this species.

HIBISCUS SCOTELLII, *E. G. Baker*, sp. nov.

H. caule ligneo ramoso non spinoso, ramis strictis stellato-pubescentibus; foliis petiolatis profunde palmati-5-lobatis, lobis serratis subtus minute incano-stellato-pubescentibus, junioribus non lobatis vel trilobatis serratis, margine et nervo medio rubro; floribus axillaribus solitariis breviter pedunculatis; bracteolis lineari-lanceolatis liberis integris nec furcatis nec appendiculatis, quam calyx brevioribus; sepalis ovatis acuminatis pubescentibus; margine et nervo medio rubro-fulvo; petalis calyce longioribus (in siccitate purpureis) capsulis parvis apiculatis, loculis 1–2-spermis; seminibus nigrescentibus sparse albo-stellato-pubescentibus.

Branches about 1 foot long; leaves 1 inch long, petiole $\frac{3}{4}$ inch; peduncle $\frac{1}{6}$–$\frac{1}{8}$ inch long.

This plant belongs to the section *Ketmia*.

Flowers yellow, on gneissose rocks by Scarcies River, 2 miles north of Sasseni, Jan., no. 4535.

CELASTRINEÆ.

SALACIA ANGUSTIFOLIA, sp. nov.

Frutex glaber, ramis nigris teretibus crebre lenticellis albis notatis; foliis lanceolatis angustis sæpe falcatis obtuse acuminatis, basi cuneatis supra rubris lucentibus subtus pallidioribus, margine obtuse serrato revolutoque; venis venulisque elevatis; venis 10–11-jugis forte curvatis et versus marginem fusis; foliis 6–10 cm. long. et 15–24 mm. lat.; petiolis rugosis supra obscure canaliculatis 6–10 mm.

Pedunculi breves (5 mm.) 15–25-flori; bracteis minutis ovatis ciliatis; pedicellis 2 cm.; calycis segmentis exterioribus ovato-triangularibus, interioribus ovato-rotundatis margine ciliatis 1–2 mm.; petalis obovato-oblongis obtusis 4–5 mm. long. et 2 mm. lat.; antheræ lobis basi divergentibus 2 mm.; filamentis 3 mm.; disco cupulare circa 1 mm.

Ovarium immaturum loculis 3–5-ovulatis.

Bafodeya highlands in Limba Country, April, no. 5486.

ANACARDIACEÆ.

ODINA (§ EUODINA) NIGRITANA, sp. nov.

Frutex ramis nigris striatis minute puberulis; foliis chartaceis 6–7-foliolatis, circa 35 cm. long.; petiolis 15 cm. long.; foliolis ovatis vel lanceolatis demum glabris longe acuminatis minute apiculatis basi valde inæqualibus quoad marginem superiorem rotundatis, ad 10 cm. long. et 4 cm. lat.; venis 10–14-jugis vix prominulis; petiolulo margine superiore 4–5 mm., inferiore 0–3 mm.

Racemi 12–16 cm. longi; bracteis ovatis 2 mm.; pedicellis 3nis, infra florem articulatis circa 6 mm. longis; sepalis 1 mm.; petalis ♀ 3 mm. long. et 1 mm. lat.; staminibus 2 mm.; drupa 3 mm.; stylis 4, 1 mm. long.

Folia glabra; foliolis majusculis ovato-lanceolatis distincte petiolulatis; foliis quam racemi glabri duplo longioribus (*cf.* Oliver, Fl. Trop. Afr. vol. i. p. 445).

A straggling shrub 10 feet high on dolerite near Buyabuya, Scarcies, Feb., no. 4769.

LEGUMINOSÆ.

INDIGOFERA SCARCIESII, sp. nov.

Fruticulus parvus, ramis luteis glaucis 10–15 cm. long.; foliis 3–7-foliolatis 1–1·5 cm. long.; foliolis crassis oblongis vel obovato-oblongis apice apiculatis petiolulatis subtus albis 3–5 mm. long. et 2–3 mm. lat.

Pedunculi axillares terminalesque 2–3 cm. long. plurime 3–4-flori; floribus sessilibus dissitis; bracteis parvis linearibus; bracteolis 2 minutis; calycis lobis linearibus acutis 2 mm.; petalis rubris calycem paullo superantibus; legumine parvo glabre 1-seminato; semine oblongo, olivaceo.

[Ceteris § Sphæridiophoræ (*vide Baker, in Oliver, Fl. Trop. Afr.* ii. p. 66) diversa foliolis 3–7, 2 lineas longis et pedunculis 3–4-floris axillaribus.]

On road near Buyabuya, Scarcies River, on hard laterite, Feb. 6, no. 4765.

INDIGOFERA SOFA, sp. nov.

Frutex 7-pedalis, ramis striatis sæpe 6 mm. diam. dense pilis albis hirsutis; foliis 2–4 cm. long.; foliolis 1–7 plurime 3, obovato-oblongis vel lanceolatis utrinque dense albo-pilosis junioribus aureo-sericeis 1–2 cm. long. et 6–8 mm. lat., petiolis supra canaliculatis petiolulis hirsutissimis; stipulis linearibus setaceis c. 5 mm.

Pedunculi axillares penduli graciles 1–10 plurime 5–7-flori; pedicellis 5–10 mm.; bracteis linearibus 3–8 mm.; calycis lobis dense hirsutis parvis; vexillo dorso sparse piloso calycem 2–3plo superante; leguminibus cylindricis suturis paullo elevatis fere glabris c. 15 mm. long. et 2 mm. diam.; seminibus 4–8 oblongis glabris lucentibus.

Ceteris § Dissitifloræ (*vide Baker, l. c.*) diversa legumine 4–8-seminato, pedunculis 1–10-floris, foliolis ½ unc. longis.

Lower slopes of Kofiu Mountain, Jan. 27, no. 4613; alluvium near Falaba, c. 3600 feet, March 12, no. 5083; in grass near Musaia, Falaba, March 9, no. 5080.

Lonchocarpus lucens, sp. nov.

Frutex ramis teretibus puberulis; foliis 7–11 foliolatis 15–20 cm. long.; rhachide supra canaliculata inconspicue hirsuta; pulvino incrassato; foliolis coriaceis ovatis lanceolatisve acuminatis basi rotundatis margine revoluto supra lucidis glabris subtus albis pilis minutis lucentibus; venis circa 9-jugis; foliolis 5–7 cm. long. et 2–2·5 cm. lat.; petiolulis sericeis 3–5 mm.; stipulis caducis.

Racemi axillares 23 cm. longi; pedunculis circa 40 brunneo-sericeis 3–4 cm. longis, flores 10–20 sessiles ferentibus; bracteis oblongis obtusis 3–4 mm.; bracteolis parvis ovatis 2 mm.; calycis dense brunneo-sericei lobis 2 superioribus connatis 4 mm. longis, 3 inferioribus tubum (3 mm.) æquantibus; vexillo oblongo circa 1 cm.; alis falcatis; carina oblique oblonga circa 1 cm.; ovulis paucis circa 4; stylo hirsuto.

Ceteris (*cf. Baker, l. c.* p. 241) diversus floribus solitariis, vexillo glabro, foliolis 7–11 lanceolatis angustis.

By small streams in Samu Country, Dec. 22, no. 4241.

Macrolobium Limba, sp. nov.

Frutex cortice griseo-glauco, ramis junioribus hirsutis; foliolis 2–6 plurime 4 coriaceis glabris obovato-oblongis obtusis vel subacutis, margine revoluto, basi inæquilateralibus supra lucidis subtus pallidioribus; venis sæpe 12–18-jugis cum venulis utrinque prominulis; foliolis 9–20 cm. long. et 4–7 cm. lat.; petiolulis rugosis crassis 2 mm.; stipulis semicircularibus 5 mm. long. et 12 mm. lat.

Paniculi axillares 5–8 cm. cum bracteis bracteolisque dense brunneo-velutini; bracteis ovatis caducis dense hirsutis 5 mm. long. et 2 mm. lat.; bracteolis robustis rigidis lignosis ovatis 15 mm. long. et 12 mm. lat.; sepalis ovato-triangularibus (2 extra petala connatis, 3 internis liberis), 6 mm. long. et 2 mm. lat.; vexillo magno cordato breviter unguiculato, 15 mm. long. et 2 mm. lat.; petalis alteris 4 sepala simulantibus.

Stamina 3; filamentis brevibus; antheris 6 mm. × 2 mm.; ovariis 4-ovulatis dense hirsutis; stylis longis inflexis.

Ceteris (*vide Oliver, Fl. Trop. Afr.* ii. p. 297) diversum stipulis orbicularibus 3 lin. long. et 9 lin. lat., paniculis 2–3-uncialibus.

Near Kurusu, Limba Country, April 7, no. 5539; near Kafogo, April 6, no. 5606.

ROSACEÆ.

PARINARIUM BENNA, sp. nov.

Frutex ramis nigris teretibus, junioribus cum paniculis calycibusque dense brunneo-velutinis.

Folia coriacea oblonga vel obovata etiam ovata obtusa rarius subacuta basi cuneata vel angustata sæpe inæquilateralia 5–12 cm. long. et 4–6 cm. lat.; costa utrinque, nervuris lateralibus (plurime 12-jugis) subtus, petiolis stipulisque dense brunneo-velutinis; facie superiore lucida obscure pilis sparsis spiculisve conspersa; facie inferiore intra venularum ramificationes profunde excavato albo-tomentosa; petiolis 5 mm.; stipulis linearibus 3–5 mm.

Paniculi terminales pseudodichotomi 5–7 cm. long. et lat.; bracteis obovatis 1–4 cm.; bracteolis linearibus; calycis tubo 6 mm. long. et 4 mm. lat., interne pilorum annulo cincto, dentibus coriaceis ovatis 5 mm. long. et 2 mm. lat.; petalis membranaceis ovatis caducis 4 mm. long. et 2 mm. lat.; ovario hirsuto.

A *P. macrophyllo*, Sabine (*cf. Oliver, Fl. Trop. Afr.* ii. p. 366), foliis basi cuneatis haud cordatis distinctum, ceteris calycis tubo gibboso diversum.

Shrub in Bafodeya hills, April, no. 5480; 6 miles north of Kundita, on laterite plateau of Talla hills, March 1, no. 5052.

GRIFFONIA ICONDERE, *Oliver*.

The stipules in my form differ from Baillon's description (Adans. tom. vii. p. 223), but it can scarcely be distinct.

Ninia Talla, Feb. 17, no. 4894.

RHIZOPHOREÆ.

DACTYLOPETALUM PARVIFOLIUM, sp. nov.

Rami graciles; floribus paucis 5–6meris. (*Cf.* ramis crebris; floribus numerosis *D. Barteri* et ramis intermediis floribus 4-meris *D. Mannii.*)

Frutex elatus foliosus, ramis gracilibus rubris 3 mm. diam. ad nodos cupularibus, juventute hirsutis.

Folia opposita ovata vel elliptica obtuse acuminata vel obtusa, margine revoluto basi cuneata nigro-punctata; costa inferiore petiolisque sparse hirsutis; venis circa 5-jugis arcuatis cum venulis utrinque elevatis; foliis 4–7 cm. long. et 2–3·5 cm. lat.; petiolis 5 mm.; stipulis ovatis 2 mm.

Flores axillares solitarii pauci; pedicellis parvis 1–2 mm.;

calycis 5–6-fid campanulati, tubo 2 mm. long., lobis ovato-triangularibus subobtusis externe fere glabris interne dense sericeo-velutinis 3 mm. long.; petalis apice fimbriatis basi cuneatis c. 7 mm. long.

Stamina 15 (vel 25?) ad basin disci ciliati circa 1 mm. lati affixa 7 mm. long.; ovario 2–3-loculare obovoideo vel globoso hirsuto 3 mm. diam.; loculis abortu 1-seminatis; seminibus pendulis teste rubro-brunneo inclusis 4 mm. long. et 2 mm. lat.

Near Kambia on Scarcies River, Jan. 5, no. 4735.

COMBRETACEÆ.

TERMINALIA ALBIDA, sp. nov.

Arbor 20-pedalis, ramis junioribus foliis floribusque dense pilis argenteis sericeis; foliis dissitis haud verticilliatis lanceolatis vel oblanceolatis acutis ad basin angustatis 10–20 cm. long. et 2–3 cm. lat.; venis 10–12-jugis; petiolo 10–15 mm.

Spicæ axillares 20–40-flori 4–5 cm. longi (floribus in parte superiore 3–4 cm. congestis); bracteis parvis 4 mm. linearibus flores 2 cingentibus; calycis lobis ovatis 2 mm. dense sericeis.

Stamina 10; filamentis inflexis; antheris ovatis subapiculatis; stylis simplicibus; nectariis rugosis parvis 1 mm. pilis albis 2–3 mm. long. hirsutis; fructu maturo incognito.

Ad *T. sericeam*, Burch., affinis.

A tree pretty common on plateau about 1000 ft. alt. (dolerite), Buyabuya on Upper Scarcies, March 8, no. 4269.

[*T. angolensis*, Welw., is a name not taken up by Lawson in Oliver's 'Flora of Tropical Africa'; there seem to be two quite distinct plants under it in the Kew Herbarium; one of these, no. 4294 Welwitsch, is very near *T. sericea*, Burch., and the other, no. 4286, comes near the species described above, but is in too bad a condition for final comparison.]

MYRTACEÆ.

EUGENIA SALICIFOLIA, *M. Laws.*

The following specimens differ from Lawson's description (in Oliver's Fl. Trop. Afr. p. 437) in the branches being hairy, not glabrous, in the leaves being hairy on the midribs, margins, and petioles, not glabrous, and the pedicels 4–6 lines, not 1–2 lines long; but they can scarcely be specifically different from Mann's specimens at Kew, and even less from Barter's 5/57 Sierra Leone.

A shrub on low hills, Kahreni, April 10, no. 5622, and Kurusu, April 6, nos. 5542, 5476 (both Limba Country).

EUGENIA JAMBOSA, *Linn.*

This species has not been hitherto recorded from Tropical Africa. I found it near Regent, Sierra Leone, no. 4069, apparently quite wild in the bush. Two monstrous specimens of Welwitsch, nos. 4589, 4590, and one in leaf only, no. 4618, seem to be also this species.

SAMYDACEÆ.

BYRSANTHUS BROWNEI, *Guill.*

A specimen of mine, of which the number is lost, agrees fairly with the figure in Deless. Icon. Sel. iii. tab. 52.

CUCURBITACEÆ.

TRIANOSPERMA, sp. nov.

Another species, unfortunately only in fruit, of this almost exclusively American genus. Duunia Talla, Feb. 16, no. 4862.

UMBELLIFERÆ.

CUSSONIA BARTERI, *Seem.*

I cannot separate my specimens (nos. 5422 and 5735) from those of Barter no. 812, but in my form the leaflets are strongly serrate, and not entire as in the description, *cf.* Oliver, Fl. Trop. Afr. iii. p. 32.

RUBIACEÆ.

BERTIERA BRACTEOLATA, *Hiern.*

The bracts in my specimen are much longer (nearly 1 inch) and the peduncles are also about 10 inches long. Near Freetown, Dec., no. 3922.

(Also a creeper, Sibange farm, *Soyaux*, no. 75 !)

GARDENIA HIERNII, sp. nov.

Frutex glaber subscandens; foliis ovatis vel elliptico-lanceolatis acutis basi inæquilateralibus cuneatis 7–14 cm. long. et 25–45 mm. lat.; venis utrinque prominulis in axillis minute excavatis ciliatisque; petiolis 3–6 mm.; stipulis triangularibus acuminatis 4 mm.

Flores lutei 2 mm. supra axillam orientes; pedunculis 3–4 cm.; bracteis minutis rigidis; calycis lobis triangularibus; corolla

7–8 cm. long. et 3 cm. lat. externe costata; antheris infra medium affixis 12 mm.; stigmate crasso fusiforme 3 mm.; seminibus numerosis.

Ceteris floribus solitariis, ramis glabris, corollâ *G. konguensis*, floribus pedunculatis diversum et a *G. Abbeokutæ* et *A. konguense* distincta venis 6–8-jugis, corolla 7–8 cm., calycis lobis 2–3 mm. (*konguense* 4–5 mm.), tubo 1 mm. vel subnullo (*konguense* 4 mm.).

Near Kafogo in Limba Country, April 7, no. 5516.

GARDENIA FERNANDENSIS, *Hiern.*

The stigma is distinctly bifid, exserted, and in other characters comes very near the genus *Macrosphyra*. Ninia Talla hills, Feb., no. 4914 and nos. 4914 & 5184.

AULACOCALYX TRILOCULARIS, sp. nov. (*Cf.* Hook. f. in Ic. Pl. t. 1126.)

Frutex 2–5-pedalis, ramis foliosis corrugatis ad nodos cupularibus junioribus appresse hirsutis; foliis obovatis oblanceolatisve apice rotundatis vel obtuse acuminatis, ad basin cuneatis glabris vel petiolo, costa, marginibusque pilis albis perpaucis notatis, 4–8 cm. long. et 15–25 mm. lat.; venis 3–4-jugis; axillis sæpe excavatis ciliatisque; petiolis 3 mm.; stipulis orbicularibus connatis hirsutis 2 mm. latis, dorso apicula 2–3 mm. ornatis.

Flores solitarii ramulis axillaribus contractis fere obsoletis producti, quorum stipulæ flores cupulis 2 brunneis membranaceis circumcingunt; cupula inferiore 1 mm., superiore 3 mm. lat.; calyce cyathiforme florem juventute protegente extus dense sericeo circa 7 mm. long., lobis subulatis; corollæ lobis contortis ovatis extus sericeis, intus nisi annulum pilosum glabris.

Anthera subsessilia haud apiculata 2 mm.; ovario 3-loculari; ovulis solitariis infra apicem pendulis; stylo hirsuto bifido; bacca rubra 8 mm. diam.; seminibus 3 vel abortu 1, 4 mm. diam.; teste rugoso.

A shrub common on gneiss rocks in waterfalls, &c., Moria, Scarcies River, Feb. 14, no. 4563; Mofari, Jan. 12, no. 4435.

VANGUERIA NIGRESCENS, sp. nov.

Frutex ramis teretibus griseis glaucis, junioribus nigris lenticellatis; foliis siccitate nigrescentibus glaberrimis (nisi venarum axillas hirsutas) oblongo-ovatis vel obovatis obtuse acuminatis subcuspidatis margine cartilagineo basi angustatis 5–8 cm. long. et 2–3 cm. lat.; venis 5–6-jugis; petiolo 6–8 mm.; stipulis interne hirsutis basi rotundatis dorso longe acuminatis 3–5 mm.

Pedunculi obscure pilosi 5–10-flori 8 mm.; pedicellis circ. 6 mm.; bracteis ovatis obtusis reticulato-venosis 8–9 mm. long. et 4 mm. lat.; calycis lobis 5 magnis lanceolatis subacutis 8–9 mm. long. et 2 mm. lat.; corollæ lobis caudato-acuminatis 15–17 mm. long. (acumine 3–4 mm.), externe pilis albis 1 mm. sparse hirsutis, interne pilis reflexis annulatis.

Filamenta 2 mm.; antheris 1–2 mm.; stigmate cylindrico magno 1–2 mm. long. et 1 mm. lat.; ovario 5-loculare.

Ceteris corollæ lobis caudato-acuminatis diversa et a *V. pauciflora* corollâ externe pilosâ, a *V. velutina* calycis lobis $\frac{1}{3}$ unc. bracteisque bene distincta (*cf.* Hiern, in Oliver, Fl. Trop. Afr. iii. p. 147).

A forest-shrub from 1000–3600 ft., near Kafogo in Limba, April 6, no. 5610; near Falaba, March, no. 5736.

IXORA HIERNII, sp. nov.

Frutex ramis griseis glaucis junioribus sparse hirsutis; foliis ellipticis acutis apiculatis margine revoluto basi cuneatis glabris coriaceis 11–14 cm. long. et 4–5 cm. lat.; venis 10-jugis cum venulis utrinque prominulis; petiolo transverse rugoso 6–8 mm.; stipulis obovatis orbicularibusve dorso apicula (3 mm.) ornatis.

Paniculæ corymbosæ 8 cm. long. et 6 cm. lat.; pedunculis primis 15 mm., secundis 13 mm., tertiis 2 mm., flores 3 fragrantes subsessiles ferentibus; bracteis minutis ciliatis; bracteolis cupularibus rubro-apiculatis; calycis lobis minutis; corollæ tubo gracili 3 cm. long., lobis oblongis obtusis 7 mm. long. et 2 mm. lat.

Filamenta ligulata undulata 2 mm.; antheris 6 mm. subsaggitalibus; disco cupulare; styli ramis 3 mm.

Ceteris inflorescentiâ ramosâ, floribus 1–2 unc. diversa et ab *I. radiata* foliis petiolatis, ab *I. odorata* bracteolis subnullis distincta (*cf.* Hiern, *l. c.* p. 162).

A shrub beside streams in dense bush on Mount Kofiu (near Scarcies), Jan. 26, no. 4596.

RUTIDEA SMITHII, *Hiern.*

Var. nov. WELWITSCHII; corollâ externe hirsutâ.

Golongo Alto, 1000 to 2400 ft., *Welwitsch, no.* 3168! Berria, Tambakke Country, Feb. 26, no. 5063.

Var. nov. SUBCORDATA.

Molembalandana, *R. C. Phillips*, 1878! Lagos, *Moloney*!

PAVETTA BACONIA, *Hiern*, var. nov. HISPIDA.

Branches, petioles, and midribs of leaves hairy; leaves as much as 25 cm. long; flowers 7 mm. long in corymbs 9 cm. in diameter.

Shrub 8 feet in rather shady places, Falaba, no. 5412.

PSYCHOTRIA LIMBA, sp. nov.

Frutex ramis viridibus subcarnosis glabris lineis albis obscuris notatis; foliis chartaceis late ovatis obtusis vel subacutis basi angustatis margine vix revoluto glabris; costa subtus lata (2–3 mm.) lineis albis (1 mm.) notata; venis albis conspicuis plurime 13-jugis; foliis 27–30 cm. long. et 9–13 cm. lat.; petiolis 3–3·5 cm. long.; stipulis 4–5 mm. lat.

Paniculæ pyramidatæ 7 cm. long. et 6 cm. diam.; pedunculis primis 25 mm. long., secundis 15 mm., paniculas trichotomas corymbosas 2 cm. long. et 15 mm. lat. ferentes; bracteis bracteolisque minutis; calycis tubo cupulare 1–2 mm. long., dentibus minutis ciliatis; corollæ tubo 3 mm., lobis apice inflexis ciliatis ad faucem piloso-annulatis 2 mm.; filamentis nigris 2 mm.; antheris 2 mm.; ovario minuto immaturo.

A *P. gabonica*, Hiern, et *P. arborea*, Hiern, differt stipulis minute bidentatis connatis, foliis 9–11 unc. longis, venis plurime 14-jugis.

A shrub in riverside woods near Lomaburu, c. 1000 feet, Scarcies Talla, Feb. 28, no. 5023; between Kahreni and Lokko in Limba below 1000 ft., April, no. 5815.

PSYCHOTRIA ALBICAULIS, sp. nov.

Frutex ramis teretibus griseis striatis ad nodos cupularibus junioribus breviter hirsutis.

Folia lanceolata vel falcata acuta margine revoluto ad basin attenuata subcuspidata plumbea, 5–10 cm. long. et 2–3 cm. lat.; venis albis prominulis plurime 7-jugis; petiolo minute tomentoso 5–10 mm.; stipulis orbicularibus dense pubescentibus margine ciliato circa 4 mm. lat.

Pedunculi terminales 1·5 cm. long.; ramis 3–5 mm.; bracteis ovatis acuminatis ciliatis 5 mm.; bracteolis minutis, calycis tubo 1 mm. alto dentibus minutis, corollæ lobis circa 4 mm. longis triangularibus; disco tumido circa 1 mm.; antheris 2 mm.

Ceteris § *Paniculatæ* diversa pedunculis brevibus (12 mm.), stipulis dense villosis, calycis lobis minutis.

Near Musaia (head of small Scarcies drainage area 2000–3000

ft. alt.), near Falaba, March 10, no. 5124; undershrub common in river-woods, Erimakuna to Farana on Niger, 3000–4000 ft. alt., March, no. 5312.

COMPOSITÆ.

VERNONIA, sp. nov.?

I should have described my specimens as a new species were it not that a specimen of Welwitsch's no. 3258 connects them with *Vernonia myriantha*, Hook. f., in such a way that it is difficult to decide how much this species may include.

Moria, Scarcies River, Jan., no. 4839; Duunia Talla, Feb., no. 4833.

VERNONIA, sp. nov.

This form seems identical with Welwitsch no. 3320, but is too poor to describe.

Dry rocky hill about 3 miles to the south of Falaba, c. 3600 ft., March, no. 5152.

VERNONIA, sp. nov.

A very distinct species with single unbranched stems about 7 feet high, found in woods near Falaba, March 15, no. 5222.

VERNONIA? (*teste Prof. Oliver*), Bojeria glabra, *Klatt*.

This is one of the most interesting species collected, but, like all the other specimens previously brought to this country, the heads had been injured by insects. It is much more like a *Protea* or *Oldenburgia* in habit than *Vernonia*, but probably comes near *V. nigritiana*, though its heads are 4 cm. long and 5 cm. in diameter. It is not uncommon in grassy hills and valleys, and probably flowers immediately after the rains (August, September). No. 4985 from Mount Gonkwi, Duunia Talla, about 3600 ft.; no. 4491 from Buyabuya, about 1000 ft.

DIANTHOSERIS, sp. nov.

A minute, tuberous-rooted plant not 4 inches high, unfortunately without leaves.

It seems very near an Eastern form, Namuli, Makua Country, collected by J. T. Last, and also to Welwitsch no. 3635.

Talla Sumbaraya, no. 5010.

SAPOTACEÆ.

CHRYSOPHYLLUM WELWITSCHII, *Engl.*

From description and comparison with Welwitsch's no. 4831, my specimen from the Limba Country between Bumban and

Lokko, April, no. 5673, seems to be this species. I cannot make out any difference in Welwitsch's other nos. 4830, 4832, 4833, of which there is a fine series in the British Museum.

EBENACEÆ.

MABA ELLIOTII, *Hiern*, sp. nov.

M. foliis alternis elliptico-ovatis vel lanceolato-oblongis apice obtuse acuminatis basi angustatis vel obtusis glabris coriaceis fere concoloribus supra nitidis mediocriter petiolatis; floribus masculis trimeris in cymis abbreviatis axillaribus lateralibusve paucifloris dispositis, pedicellis brevibus bracteatis, bracteis parvis rotundatis minute vel obsolete ciliolatis imbricatis, calyce parvo breviter trifido lobis rotundatis minute vel obsolete ciliolatis, corollâ tubulosâ breviter trilobâ tubo calycem excedente lobis obtusis patulis, staminibus 9 basi corollæ insertis antheris linearibus filamentis glabris, ovario 0; floribus femineis ignotis.

A bushy tree, 10 to 16 feet high, diœcious, glabrous nearly throughout. Branches dusky, spreading at about half a right angle, leafy; internodes $\frac{3}{8}$–$\frac{7}{8}$ in. long. Leaves quite entire, more or less marked above with depressed lines along the midrib and along the slender lateral veins, about 6 on each side of the midrib, grey-green (in the dry state), $2\frac{1}{2}$–4 in. long by $1\frac{1}{8}$–2 in. broad; margin narrowly recurved; petiole $\frac{1}{8}$–$\frac{1}{4}$ in. long, rather thick and wrinkled when dry.

In the male plant flowers clustered about 3 together in the axils of present or fallen leaves or lateral on the branches, $\frac{1}{4}$–$\frac{1}{3}$ in. long. Bracts shorter than the calyx, the outer ones very short. Calyx $\frac{1}{10}$–$\frac{1}{8}$ in. long, campanulate. Corolla considerably exceeding the calyx, narrowly urceolate-oblong, toughly fleshy, quite glabrous or outside obsoletely puberulous?; lobes sinistrorsely contorted (as regarded from inside) in the bud. Stamens consisting of 3 pairs alternating with 3 single ones, in each pair the stamens are placed one in front of the other and united by their filaments; the anthers glabrous or sometimes clothed with a few hairs at the back on the lower part.

Sierra Leone; near Musaia, Falaba; in riverside woods, 9th March, 1892. Collected by Mr. G. F. Scott Elliot, no. 5101, in whose honour the species is named.

Mr. Scott Elliot saw the same species also in the Limba Country at Kafogo, where on April 6, 1892, he collected some fruiting specimens, no. 5613, of a *Maba*, perhaps belonging to this same species; they differ, however, from no. 5101 by the extremities of the branches being somewhat hairy and by the upper surface of the thinner leaves being more deeply marked by depressed lines alongside the principal veins.

No. 5613 presents the following characters:—

Branches glabrous except the young parts, brown-dusky, rather slender; the internodes mostly $\frac{3}{8}$–$\frac{3}{4}$ in. long, and the young shoots beset with very short black hairs. Leaves alternate, elliptical, acuminate, more or less narrowed at the base, prolonged towards the apex into a narrow and rather obtuse acumen, $1\frac{1}{2}$–$4\frac{1}{2}$ in. long by $\frac{7}{8}$–$1\frac{2}{3}$ in. broad, thinly coriaceous, of nearly the same colour on both surfaces, glossy; lateral veins (in the dry state) much depressed above and in relief beneath; petiole $\frac{1}{12}$–$\frac{1}{10}$ in. long, glabrate or hispid with some black hairs. Fruit-calyx $\frac{1}{4}$ in. diam., glabrous, appressed to the base of the fruit; lobes 3, short, rounded, nearly black. Fruit-peduncle $\frac{1}{8}$–$\frac{1}{6}$ in. long, glabrous. Fruit depresso-globose, solitary, lateral, glabrous, nearly black, rather glossy, 1 in. diam., $\frac{3}{4}$ in. long, 3(?)-celled. Seeds 3, about $\frac{1}{2}$ in. long, $\frac{1}{4}$ in. broad, $\frac{1}{6}$ in. thick.; albumen not ruminated.

Maba Elliotii appears to belong to the section HOLOCHILUS, and can be placed among the species between *M. quiloënsis*, Hiern, of East Tropical Africa, and *M. micrantha*, Hiern, of Bombay.

OLEACEÆ.

JASMINUM BAKERI, sp. nov.

Frutex subscandens, ramis teretibus glabris minute striatis, foliolis late ovatis acutis apiculatis margine revoluto basi cuneatis terminalibus 55–90 mm. longis et 35–65 mm. lat. (lateralibus 40–70 mm. long. et 27–55 mm. lat.); petiolulis 3–4 cm. cum petiolo (3–4 cm.) supra canaliculatis.

Cymis dense niveo-tomentosis; pedunculis infimis 4 cm.; bracteis bracteolisque linearibus 3–7 mm.; floribus 1–3nis plurime sessilibus; calycis tubo dense hirsuto 2 mm.; dentibus linearibus obtusiusculis 2 mm.; corollæ 1 cm. longæ, lobis ovatis apiculatis basi subcordatis 2–3 mm. longis; filamentis brevissimis; antheris apiculatis 2–3 mm.; baccis rubris ellipsoideis 1 cm. × 7 mm.

Ceteris Africanis foliis trifoliolatis petiolulatis, ramis glabris, paniculis tomentosis, calycis dentibus 2 mm., foliorum non triplinervium nervuris plurime 4–5-jugis apud clavem cl. Baker. ineditum bene distinctum.

Berria, near Falaba, c. 3000 ft. alt., March 30, no. 5409.

APOCYNEÆ.

(By Dr. OTTO STAPF.)

CLITANDRA CYMULOSA, *Benth.*

The specimens are only in fruit, but agree with this species so far as leaf, branch, and inflorescence go. I do not feel quite sure as to the determination, however, as the species of this genus so much resemble each other in habit and foliage.

Fruits oblong, 2·5 cm. long; pedicels 3 mm.

LANDOLPHIA HEUDELOTII, *A. DC.*

Var. DJENGE vel species nova?

Specimina fructifera habitu foliisque *L. Heudelotii* sed fructibus globosis 2–3 cm. diametientibus, haud pyriformibus.

Djengé of Mendi people near Kukuna, about 400 ft. alt., Jan., nos. 4650, 4675; schistose rocks near Falaba, March, no. 5450; Kahreni, Limba, April, no. 5586.

CARPODINUS, sp.

Specimen in leaf only.

Beside a stream on Kofiu Mountain near Laya, Jan., no. 4611.

VOACANGA AFRICANA, *Stapf*, sp. nov.

Frutex vel arbor humilis; foliis obovatis usque obverse lanceolatis rarius oblongis vel ovatis sessilibus semiamplexicaulibus vel interdum plus minusve petiolatis glabris vel subtus in costa, raro in parenchymate quoque, molliter puberulis; cymis in corymbis binis terminalibus breviter vel longiuscule pedunculatis sæpe floribundis; calyce cum lobis obtusis 8–10 mm. longo; corollæ tubo breviter exserto, lobis 1·5 cm. longis.

A shrub or small tree, 3–5 m. high, with very variable foliage; the leaves are either sessile and semi-amplexicaul or more or less distinctly petioled, the petiole attaining 1–1·5 cm., rarely more; the lamina varies from 6–25 cm. in length and from 4·5–12 cm. in breadth and in all shapes between ovate and obverse-lanceolate, but generally it is obovate; the base is always narrowed, and more often cuneate than abruptly contracted; the apex varies from shortly acuminate to acute and obtuse; the leaves are membranous, glabrous above and beneath or more or less softly puberulous beneath, particularly on the midrib; the lateral nerves number about 11 on each side, and they stand closer or farther apart according to the length of the leaf; they rise at an angle of 50–60° and are strongly arched in their outer third. The inflorescence, which is glabrous or sparingly pubescent, is formed by two opposite and terminal flowering branches which bear generally many-flowered corymbs on robust or slender peduncles of 5–15 cm. length; the pedicels are 1–2 cm. long; the calyx-tube is obovoid and of the same length as the lobes, which are often reflexed at last; the corolla is white and its tube, which is about 1 cm. long, is widened in the middle; the spreading lobes are obovate or oblong. The anthers are 5 mm. long, sagittate, very acute and almost sessile. The style is widened below the stigma into a cup-shaped cuff. The carpels are free, surrounded by a low, obtusely lobed disk, and they contain numerous ovules in several rows on a peltate placenta. The fruit is a many-seeded pear- or apple-shaped berry, about 4–5 cm. long, with a thick pericarp and numerous ovoid or oblong seeds of about ¾ cm. length. A sketch made by Sir J. Kirk on the spot, as well as the fruiting specimen in the herbarium, show only one berry, the other carpel having evidently become abortive.

Ninia Sumbaraya, no. 4903; Bafodeya, no. 5484.

This is a widely distributed species, which I know from the following localities:—Shupanga, Zambesi Exp., *Kirk*, 1862; between Sena and Lupata, Livingstone, S. Afr. Exp., *Kirk*, 1859; about 60 miles up the River Shiré, Livingstone, S. Afr. Exp., *Kirk*, 1859; Shiré Highland, *Buchanan* no. 9; Angola, *Welwitsch* no. 5978; Fernando Po, *Mann* no. 243; Abbeokuta, Niger Exp., *Barter* no. 3376; Nupe, Niger Exp., *Barter* no. 1327; Lagos, *Moloney*, 1883; Gambia, Bathurst, *M. Skues*; Senegal, *Heudelot* (?) no. 89.

Welwitsch's no. 5979 consists of leafy branches like those of 5978 and a detached partial inflorescence with flowers, larger than in any specimen of *V. africana* I have seen, but about equal to those of no. 5980 of Welwitsch's collection, which has also somewhat different leaves with more numerous nerves. Nevertheless I should suggest that this is also but a form or variety of *Voacanga africana*.

ECTINOCLADUS BENTHAMII, *Baill. Hist. pl. Apocyn.* 211 (nomen solum).

As this species is only known from the generic characters given in the 'Genera Plantarum' for *Ectinocladus*, I think it best to describe it here more in detail.

Frutex 5–10 mm. alte scandens, ramis novellis minute tomentellis mox glabratis teretibus divaricatis; foliis oppositis petiolo 4–6 mm. longo suffultis obovato-oblongis vel obverse lanceolatis rarius lineari-lanceolatis, 4–5 cm. longis, 0·7–2 cm. latis, basi cuneatis apice obtusis rarius obtuse subacuminatis coriaceis glaberrimis, nervis lateralibus utrinque circiter 8 rectis in nervum marginalem arcuatim collectis, venis quasi e nervo marginali costam versus emissis ramificatis cum venulis nervis lateralibus subparallellis utrinque prominulis; cymis laxis in ramis ramulisque terminalibus vel obfolia ramulorum valde reducta vel suppressa specie axillaribus minute puberulis, bracteis minutis, pedicellis 5–7 mm. longis; calyce 5-partito vix 2 mm. longo, lobis obtuse ovatis; corolla hypocrateriformi, tubo basi dilatato 4 mm. longo, lobis obovato-oblongis 8 mm. longis, margine ciliatulis, in alabastro dextrorsum tortis atque obtegentibus, demum reflexis; staminibus basin tubi corollini versus inclusis, filamentis triangularibus 1 mm. longis pilis erectis obsitis, connectivo postice ad ½ patule piloso; antheris sagittatis subulato-acutatis basi in appendiculos lineares acutas vacuas productis cum iis 2 mm. longis circa stigma conniventibus et ei medio ope glutinis e cavitate inter loculorum basin et filamenti apicem in linguam deflexam productum emissi adhærentibus; disco annulari minuto, carpellis 2 distinctis ovatis tomentellis 1¼ mm. longis; stylo clavato medio in cupulam lobulatam ampliato, stigmate ovoideo; ovulis numerosis; quoad folliculos mihi tantum e specimine Thomsoniano notos vide Gen. Plant. *l. c.*

Usually by riversides, near Mofari, Scarcies River, no. 4440.

Ectinocladus, sp. ?

Without locality.

There is but a fruiting branch in the collection. The leaves are obovate and abruptly acuminate, dark green above and pale beneath, and their nervation is quite of the type of that of *Ectinocladus Benthami.* They are 4·5–6 cm. long and 2–3 cm. broad. The only follicle is spreading horizontally, almost 20 cm. long and 8 mm. thick and cylindric. The seeds are oblong-linear, 1½ cm. long and 3 mm. broad, with a sessile tuft of white hairs 4 cm. long.

Baissea leonensis, *Benth.*

Near Bafodeya, no. 5500.

Baissea caudiloba, *Stapf*, sp. nov.

Frutex scandens ramulis minutissime puberulis; foliis obovato-ellipticis vel ellipticis basi rotundatis vel minute cordatis, nervis lateralibus utrinque circiter 6; inflorescentiis minutissime puberulis; calyce puberulo quinquefido lobis triangulari-lanceolatis; corollæ lobis caudato-linearibus flexuosis.

A climbing shrub with slender branches, petioles 3 mm. long, lamina 8–10 cm. long, 4–5 cm. broad, shortly acuminate, quite glabrous, with rather distant nerves, which rise at an angle of 45°, and with a reticulation very like that of *B. leonensis*; cymes in terminal and axillary panicles, the latter few and from the uppermost axils only; peduncles 1–1½ cm. long, with small bracts; pedicels ¼–¾ cm. long, calyx 2 cm. long; corolla white, tube short, almost campanulate, 4–5 mm. long, lobes narrow, 1¼–1½ cm. long; andrœcium and gynæcium as in *B. leonensis.*

Near Ninia Talla hills, no. 4807.

Kickxia africana, *Benth.*

Near Kukuna, no. 4506.

Apocynea quoad genus dubia.

Frutex glaberrimus, ramis teretibus tenuiter striatis nigricantibus; foliis oppositis petiolatis ovato-oblongis vel oblongis basi breviter acutis apice obtusiusculis vel rotundato-obtusis tenuiter coriaceis pallidis, supra subglauco-viridibus, subtus flavido-viridibus, lucidulis, nervis lateralibus patulis parallelis utrinque 25–30 sub margine ipso arcuatim collectis utrinque prominulis, venulis areolas elongatas nervis parallelas ambeuntibus; cymis terminalibus raro axillaribus paucis additis breviter pedunculatis dense corymbosis minute bracteatis, pedicellis nullis vel brevissimis, resinam gummosam esudentibus; calyce ad medium 5-lobo, lobis rotundato-ovatis intus eglandulosis; corolla hypocrateriformi tubo superne leviter dilatato intus pilosulo, lobis in alabastro dextrorsum contortis sinistrorsum obtegentibus, oblongo-linearibus obtusis; staminibus in parte superiore corollæ tubi insertis, filamentis brevissimis, antheris ovatis basi bilobis inappendiculatis apice obtusiusculis; carpellis 2 distinctis stylo filiformi sub stigmate bilobo ellipsoideo-incrassato et dense papilloso, placentis peltatim affixis; ovulis 10–12 3-seriatis. Fructus ignotus.

Near Makunde, Limba Country, no. 5690.

Said to be used in making combs.

I am not able to refer this species to one of the described genera, and yet hesitate to found a new genus upon it in the absence of fruits. As far as the floral structure is concerned it seems to belong to the group of *Plumeria*, whilst the general habit is quite that of *Clitandra*.

ASCLEPIADACEÆ.

TACAZZEA APICULATA, *Oliver*, var. nov. BENEDICTA, *S. Ell.*

Caules juniores albo-velutini; venis 9-jugis; foliis 7–12 cm. long. et 3–6 cm. lat.; petiolis 2–4 cm.; coronæ squamis filiformibus 12 mm.; corollæ lobis 6 mm.

This form differs so little from the specimens brought by the Speke and Grant Expedition and Schweinfurth from the head of the Nile that it can scarcely be taken as other than a Niger variety.

"Wakwangé." The powdered leaves when rubbed on the skin immediately remove the itching of crawcraw; by Dantilia River between Niger and Falaba, March 23, no. 5269.

RAPHIONACME BROWNII, sp. nov.

Herba radice tuberoso lignoso 4 cm. diam.; caulibus 25–35 cm. striatis lignosis obscure asperatis; foliis sparsis anguste linearibus planis 2–3 cm. long. et 1–2 mm. lat.

Inflorescentia tota calycibusque densiuscule lepidis albis minutis conspersis; pedicellis 1–2 cm.; bracteis acutis 3 mm.; calycis campanulati lobis ovatis acutis dorso puberulis 2 mm.; corollæ tubo 4 mm. glabro, lobis oblongis densius externe lepidotis 3 mm.; coronæ squamis ad corollæ tubum affixis quam lobi paullo longioribus et iisdem alternis filiformibus hirsutis; filamentis basi in membranam orbicularem expansis supra squamas ad corollam affixis; antheris apiculatis; folliculis 15 cm. longis, 4 mm. latis.

Flowers pink, growing on dry schistose or gneissose rocks, alt. c. 3500 ft., Falaba, March 15, no. 5179.

I have great pleasure in naming this after Mr. N. E. Brown, whose careful study of the order has been of the greatest service to me.

PERIPLOCA NIGRESCENS, *Afzel.*

Samu Country, Dec. 26, no. 4206; Kurusu and Kahreni, Limba, April, no. 5631.

Toxocarpus leonensis, sp. nov.

Frutex foliosus volubilis, cortice rubro-glauco juventute viride minute pilis ferrugineis tomentosus; foliis ovatis acutis margine revoluto basi angustatis subtus pallidioribus 3–4 cm. long. et 13–17 mm. lat.; venis 7–9-jugis; petiolis 1–2 mm.

Pedunculi 5–12-flori cum pedicellis sparse ferrugineo-tomentosi 10–25 mm. longi sæpius ramos 5, 5–10 mm. longos (quorum 2 ad medium et 3 terminales sunt) ferentes; pedicellis sæpius ternis 4 mm.; calycis lobis ovatis obtusis margine ciliato intus glandulis parvis auctis; corollæ lobis aurantiacis oblongis obtusis 3-nerviis; coronæ squamis minutis 1 mm. carnosis dorso staminibus affixis; antheris membranâ breve ciliatâ coronatis; stylo 1–2 mm. supra gynostegium protruso profunde bilobo.

A shrub on Sugarloaf Mountain, Sierra Leone, April 26, no. 5773.

Xysmalobium Heudelotianum, *Decne.*?

I cannot be sure, from the description in DC. Prod. viii. p. 520, whether the following numbers really belong to this species. In my form the leaves are not at all scarious at the margin, and the lobes of the corona are ovate, keeled internally, and not either acuminate or tumid; but I fancy it is just the same plant.

Dry rocky hills about 3600 ft., Falaba, March. 14, no. 5183.

Cryptolepis triangularis, *N. E. Br.*, sp. nov.

Caulis volubilis, glaber, foliis petiolatis, $1\frac{1}{4}$–3 poll. long. $\frac{1}{2}$–$1\frac{1}{8}$ poll. lat., ellipticis oblongisve, acuminatis, ad basin rotundatis, tenuiusculis, glabris; petiolis $\frac{1}{4}$–$\frac{3}{8}$ poll. long.; cymis axillaribus, vel ad apices ramorum lateralium terminalibus; pedunculis glabris, $\frac{1}{3}$–1 poll. long. dichotomis, floribus paucis, bracteatis; bracteis $1\frac{1}{2}$–2 lin. long. ellipticis oblongis obtusis, pedicellis $\frac{1}{4}$–$\frac{3}{4}$ lin. long.; sepalis $\frac{1}{8}$ poll. long., oblongis obtusis; corolla lutea, glabra, tubo campanulato 2 lin. long., lobis lineari-lanceolatis 6–7 lin. long., leviter ad basin oblique auriculatis, coronæ lobis $\frac{1}{2}$–$\frac{3}{4}$ lin. long., medio corollæ tubi enatis, dimidio apicali in laminam triangularem vel ovato-triangularem abrupte dilato, ex omni parte æqualibus, angulis acutis orbiculatisve, erectis vel inflexis.

Stem twining, glabrous.. Leaves petiolate, $1\frac{1}{4}$–3 in. long, $\frac{1}{2}$–$1\frac{1}{8}$ in. broad, elliptic or oblong, acuminate, rounded or subacute at the base, rather thin, glabrous; petioles $\frac{1}{4}$–$\frac{3}{8}$ in. long. Cymes axillary or terminating short lateral shoots, on glabrous peduncles $\frac{1}{3}$–1 in. long, dichotomously two-branched, few-flowered, bracteate;

bracts $1\frac{1}{2}$–2 lines long, elliptic-oblong, obtuse; pedicels $\frac{1}{4}$–$\frac{3}{4}$ in. long. Sepals $\frac{1}{8}$ in. long, oblong, obtuse. Corolla yellow, glabrous, with a campanulate tube 2 lines long, and linear-lanceolate lobes 6–7 lines long, slightly auriculate on one side at their base. Coronal lobes arising from the middle of the corolla-tube, $\frac{1}{2}$–$\frac{3}{4}$ line long, the apical half abruptly dilated into a triangular or ovate-triangular blade with equal sides and acute or rounded angles, erect or horizontally inflexed.

Upper Guinea.—Nupe, *Barter* 1333!, Abbeokuta, in rocky place, *Barter* 3359!

Lower Guinea.—Angola, *Welwitsch* 5993!

VINCETOXICUM (§ CYNOCTONUM) MANNII, sp. nov.

Scandens, caulibus striatis minutissime puberulis; foliis ovatis acuminatis acutis basi cordatis supra viridibus opacis subtus albidis glaucis 3-nerviis 4–7 cm. long. et 17–43 mm. lat.; nerva infima brevi, laterali fere usque ad apicem currente et cum costâ nervuris plurime 3 convexa; petiolo 15–30 mm.

Pedunculi sparse hirsuti 2–3 cm. longi; bracteis minutis ciliatis; pedicellis 15–25 dissitis 4–7 mm. longis; calycis lobis ovatis subobtusis 1–2 mm.; corollæ lobis apice subinflexis obtusis 4–7 mm.; corona cupulari infra medium 10-fida 3–4 mm.; antheræ membranâ ovatâ ciliatâ.

A *Cynoctono abyssinico*, Hochst., foliis triplinerviis, et specie nondescripto (Schweinfurth 3345 et Welwitsch 4200) pedicellis dissitis bene distinctum; species valde affinis in herb. Kew. (Soyaux 277, Burton, Mann 765, Kalbreyer 3) sed pedunculis nullis nondescriptum est.

Bagroo River, *Mann* 1861!; between Bumban and Lokko, *Scott Elliot* no. 5672; Kabusa Limba, April 8, no. 5479.

SOLANACEÆ.

SOLANUM SCALARE, *C. H. Wright.*

Caulis suffruticosus, inermis, cylindricus, pilis stellatis vestitus. Folia oblonga, marginibus sinuatis, pilis stellatis utrisque faciebus vestita. Inflorescentia supra-axillaris, racemosa; flores circa 10. Calyx 5-partitus, segmentis oblongo-acutis. Corolla 5-partita, segmentis oblongis, calyce duplo longiore, extra pilis stellatis vestita, intra (nisi nervium) glabra. Stamina 5; antheris subsessilibus, poris terminalibus dehiscentibus. Ovarium globosum; stylus filiformis, pilis stellatis tomentosus. Bacca globosa, 0·5 cm., coccinea.

"Small Yakatu," "Kofé," or "Banjangé" of natives. Mofari, *Scott Elliot* no. 4394, Sikuro, no. 4898; Sierra Leone, *Garrett* no. 18; Lagos, *Rowland* 4; Yoruba, *Moloney*; Kworra, *Barter*; Angola, *Welwitsch* 6089, 6090, 6104.

SCROPHULARINEÆ.

DOPATRIUM NANUM, sp. nov.

Herba nana filiformis, caule glabro-glauco simplice vel versus apicem semel bisve ramoso 10–20 cm. alt.

Folia radicalia, subnulla, caulina ad bracteas ovatas subacutas basi subcordatas 2 mm. longas reductis.

Pedicelli 2 cm.; sepalis membranaceis obtuse apiculatis obscure 3-nerviis 3 mm. longis; corollæ tubo glabro cylindrico purpureo 15 mm. longo et 2–3 mm. lato (lobis c. 4 mm. obtusis?).

Filamenta infra medium tubi affixa 2–3 mm.; antheris oblongis; stylo c. 3 mm.; stigmate late 2-lamellato; capsula obscure punctata 4 mm. × 3 mm.

D. senegalensi proxime affinis sed caulibus gracilioribus cum corollis glabris diversum.

Buyabuya, on Scarcies River, about 700 ft., Feb. 7, no. 4275.

The other new and doubtful forms have been assigned to Mr. W. B. Hemsley for determination and description.

ACANTHACEÆ.

The new and doubtful forms have been placed in the hands of Mr. R. A. Rolfe, who has undertaken to describe them for the 'Flora of Tropical Africa.'

LABIATÆ.

ANISOCHILUS AFRICANUS, *Baker*, sp. nov.

Herba perennis, ad 4 pedes alt., caulibus erectis, ramulis dense pubescentibus; foliis dissitis, subsessilibus, oblongo-lanceolatis, crenatis, subcoriaceis, pagina superiore subscabra, pagina inferiore dense pubescenti venulis prominulis, infimis 4–5 poll. long.; spicis compactis, parce paniculatis, pedunculatis, cylindricis, pedicellis obsoletis; calyce post anthesin $\frac{1}{6}$ poll. long.; labia superiore oblonga, concava, deflexa, tubum excedente, labia inferiore suborbiculata; corolla $\frac{1}{4}$ poll.

A perennial herb 4 feet high, with erect stems and densely and shortly pubescent branches. Leaves distant, nearly sessile, oblong-lanceolate, crenate, subcoriaceous, subscabrous above, densely pubescent with raised veinlets beneath, the lower 4–5 inches long. Spikes very dense, sparingly panicled, peduncled, cylindrical, the end one 3–4 in. long; pedicels obsolete. Fruit-calyx ⅙ in. long; upper lip oblong, concave, deflexed, much longer than the tube; four lower suborbicular. Corolla ¼ inch.

In alluvium, Freetown, no. 5033.

POLYGONACEÆ.

SYMMERIA PANICULATA, *Benth.*

The female of the African form does not seem to have been collected before. I find scarcely any good distinctions between it and the American plant.

"Mongmoi" of Mendi, near Kambia, on Scarcies, Jan. 7, no. 4467; near Madina, Limba Country, April 11, no. 5662; also Kahreni, no. 5573.

ARISTOLOCHIACEÆ.

ARISTOLOCHIA LEONENSIS, *Mast.*, sp. nov.

Scandens, ramis suberosis crassitie pennæ anserinæ; foliis remotiusculis petiolatis, petiolis pollicaribus antice sulcatis, laminis c. 4½ poll. long., 2½ poll. lat., coriaceis glabris oblongis sensim acuminatis basi subrotundis palmatim 3-nerviis, venis paucis arcuato-reticulatis; racemis e ramorum lateribus emergentibus, erectis 1–2 poll. longis plurifloris; ovario lineari-oblongo puberulo; perianthio tubulato circa 1⅓ poll. long. pedicellum cum ovario paulo superante, tubo angusto rectiusculo, basin versus oblique ventricoso medio intus pilis rufescentibus instructo et ad initium partis ventricosæ processu carnoso annulari tuberculato munito, limbo cupulato late 3-lobo, lobis patentibus deltoideis petaloideis, fauce annulo carnoso circumdato; staminibus 6; processibus stigmatosis carnosulis late oblongis obtusis conduplicatis ad margines pilosiusculis.

Near Kassa, alt. 3600 ped., no. 5062.

PIPERACEÆ.

PEPEROMIA, sp. nov.

Unfortunately, like Barter's specimen from the same hill, this is a male plant; but it is a very distinct form.

On Sugarloaf Mountain, April 26, no. 5755.

LORANTHACEÆ.

LORANTHUS BELVISII, *DC.*

This species seems confined to Sierra Leone and Cape Coast, at least if the forms so marked in Kew Herbarium really belong to it. These are *Vogel* nos. 44 & 45, Cape Coast, wrongly marked "*Ansell*, Grand Bassa;" no. 88 *Vogel*, Sierra Leone; 5/57 *Barter*, Sierra Leone, to which belong my numbers 3916, bush near Sierra Leone, Dec. 4; 4720, near Kukuna on Scarcies River, and 5783, Sugarloaf Mountain, April 26.

Ansell's plant from Grand Bassa seems to me a different species, very likely *L. sessilifolius*, Beauv., but the calyx and bracts figured in the 'Flore d'Oware,' tab. 64, are exactly like those of Vogel's, Barter's, and my specimens, and not like those of Ansell's. It is even quite possible that the whole determination is wrong, as the corolla is not *lateraliter fissa* in any way.

LAURINEÆ.

BEILSCHMIEDIA ELATA, sp. nov.

Arbor ramis glaucis glabris; ramulis striatis; foliis coriaceis acutis etiam acuminatis vel obtusis inæquilateralibus basi cuneatis glabris 10–18 cm. long. et 5–7 cm. lat.; venis 6–9-jugis cum venulis utrinque prominulis; petiolis rugosis supra canaliculatis torsis 8 mm. long.

Paniculi ampli ramosi, ramulis 5–7, in axillis foliorum superiorum aggregatis 7–15 cm. long. et 10 cm. lat.; bracteis ovatis ciliatis 1-2 mm.; pedicellis sub flore articulatis 3–6 mm. longis; perianthii tubo campanulato 2 mm.; segmentis rotundato-ovatis ciliatis 1 mm.

Stamina 9 similia; filamentis applanatis dense ciliatis; staminodiis minoribus subsimilibus; glandulis cylindricis carnosis sessilibus staminibus alternis; ovario rotundato; stylo 1 mm.; fructu pyriformi basi angustato coriaceo 4 cm. long. et 2 cm. lat.

Ceteris paniculis ramosis glabris et staminodiis hirsutis diversa.

Tree 20 feet high, Old Calabar River, Feb. 1863, 2255 *a*, *G. Mann*! Near Musaia, Falaba, March 10, no. 5125; Mofari, Scarcies River, Jan. 12, no. 4400.

EUPHORBIACEÆ.

CROTON SCARCIESII, sp. nov.

Frutex riparius, ramis striatis subglabris; foliis chartaceis

oblanceolatis vel obovatis obtusis versus basin angustatis sed ima basi rotundatis maturitate subglabris 15 mm.–40 mm. longis et 8 mm.–27 mm. latis; venis plurime 4-jugis; petiolo hirsuto 1–2 mm.; stipulis brunneis triangularibus ciliatis.

Flos ♂ pedunculo hirsuto sparsifloro 5–20 mm. long.; bracteis ovatis acuminatis 2–3 mm.; pedicellis 4 mm.; calycis campanulati lobis obovatis obtusis; staminibus 5–6; filamentis medio applanatis hirsutis.

Flos ♀ solitarius subterminalis pedunculo circa 5 mm.; calycis coriacei lobis lanceolatis acutis hirsutis 3 mm.; disco pentangulari; ovario asperato dense hirsuto; seminibus nitidis 3–4 mm. longis et 2–3 mm. latis.

On rocks partly in water by Scarcies River at Sasseni, Jan. 14, no. 4518, and Mofari, Jan. 12, no. 4432.

Croton nigritanum, sp. nov.

Frutex foliosus cortice glauco griseo; foliis ovatis ellipticis lanceolatisve obtuse breviterque acuminatis margine serrato revolutoque basi glandulis patellæformibus breviter pedunculatis auctis subtus pallidioribus pilis lepidisve paucis sparse conspersis 3–8 cm. longis et 15 mm.–3 cm. lat.; venis circa 7-jugis; petiolo dense lepidoto 5–10 mm.; stipulis membranaceis brunneis ovatis ciliatis 2 mm.

Racemis 3–8 cm. long.; bracteis linearibus acutis plurime 2-floris 1–2 mm.; floris ♂ sepalis 5 ovatis acutis dorso dense stellato-pubescentibus 2 mm.; petalis spathulatis apice ciliatis 2 mm.; staminibus 10 introrsis; floris ♀ calycis lobis oblongis obtusis dorso pilis stellatis hirsutis; ovario dense piloso; seminibus brunneis nitidis obscure punctatis.

Ceteris (*vide* Muell. Arg. in DC. Prod. xv. pt. 2, p. 528) bracteis infimis flores ♂ et ♀ stipantibus, ramis lepidotis, stylis semel dichotomis, staminibus 10 diversum

An undershrub in woods by river at Farana, alt. c. 3600 ft., March 26, no. 5379; Makundé, Limba, April, nos. 5715 & 5716.

Baccaurea sparsiflora, sp. nov.

Frutex cortice griseo ramulis junioribus viridibus hirsutis; foliis ovato- vel obovato-oblongis chartaceis acutis acuminatis margine obscure undulatis dentatisque basi sæpius rotundatis maturitate subglabris sed juventute dense sericeis et marginibus costaque utrinque semper plus minus hirsutis 11–18 cm. long. et

5–7 cm. lat.; venis circa 7-jugis (angulam 60° cum costa facientibus) cum venulis utrinque prominulis; petiolis hirsutis sub folia et in pulvinu incrassatis etiam lignosis 2–6 cm. long.

Racemi tenues 2–4 cm. fere a basi floriferi sparse hirsuti; bracteis parvis ovatis; bracteolis 2 minutis; pedicellis 1 mm.; floris ♂ calycis lobis 4 membranaceis oblongis obtusis 1–2 mm.; disci glandulis 5 liberis; filamentis petala superantibus; antheris introrsis rotundatis; ovarii rudimento hirsuto; floris ♀ calycis campanulati lobis 4 ovatis obovatisve 1–2 mm.; disco annulari ciliato; ovario 2-loculari ovoideo; stylis brevibus apice breviter hispidis; fructu maturo rubro purpureove 15 mm. long. et 12 mm. lat., glandulis calciferis ornato; pericarpio coriaceo; columella colorata persistente; seminibus duris sæpe abortu solitariis 6 mm. long. et 4 mm. lat.; ala vel pulpo siccato reticulato-venoso 3 mm. lat. cinctis.

Ceteris (*cf.* Muell. Arg. in DC. Prod. xv. pt. 2, p. 465) ramulis annuis foliosis flores ferentibus diversa.

A climbing-shrub common in bush by rivers, Wallia, Jan. 31, no. 4746, Sasseni, Jan. 14, no. 4543, both on Scarcies River; Luseniya, Samu Country, Dec. 20, no. 4035; near Kahreni, Limba, no. 5813; by the Niger, Farana, March 26, no. 5311.

ANTIARIS TOXICARIA, *Lesch.*, var. AFRICANA, *S. Ell.*

A tall tree with milky juice; stem hairy; leaves obovate or oblong acuminate subserrate, margin unequal and rounded or subcordate at base.

Near Lagos, *Moloney*, Oct. 1883! Tree 20 ft., Nupe on Niger Expedition, *Barter* 1102 & 1129! Small tree resembling *Antiaris toxicaria*, Idda, *Barter* 1674! Am Baginze, 28 May, Niamniam land, *Schweinfurth* 3826! Tree abounding in a pleasant milky juice, Fernando Po, 6/57, *Barter*! A very tall tree near Kukuna, Scarcies River, Jan., *Scott Elliot* no. 5892.

COMMELINACEÆ.

COMMELINA ELLIOTII, *C. B. Clarke et A. B. Rendle*, sp. nov.

Glaber aut sparse pubescens, foliis 2–4-uncialibus, elliptico-lanceolatis vel oblongo-lanceolatis, parum pilosis; pedunculis axillaribus 6 lin., sparse pubescentibus; spathis complicatis ovato-lanceolatis, nec cucullatis; marginibus basi pilosis haud connatis, interne hispidis externe glabris nisi basi venis sparse hispidulis; seminibus 5, levibus.

This is not very near any African species; it is near the Indian *C. Hasskarlii*, C. B. Clarke, which has less acuminate spathes and much larger seeds.

Between Kahreni and Port Lokko in Limba Country, April, no. 5749.

GRAMINEÆ.

(By A. B. RENDLE, F.L.S.)

PANICUM, sp. nov.

Material insufficient for description, no. 5097.

ARISTIDA DELICATULA, *Hochst.* No. 5332.

ANDROPOGON (§ SCHIZACHYRIUM) MINIMUS, *C. B. Clarke et Rendle*, sp. nov.

Herbula culmo tenui, gracillimo, decumbente vel suberecto, 5–6-uncialis, ex omnibus fere nodis ramos floriferos procreans filiformes plures, iterum ramuloso; laminis acutiusculis 4-6 lineis longis $\frac{1}{4}$–$\frac{1}{2}$ linea latis; racemis gracillimis; spiculis sessilibus oblongo-lanceolatis viridibus, gluma prima chartacea, bidenticulata, carina superne scabridula, secunda mutica obtusiuscula, carina scabridula.

Dry open bare paths on augite, near Regent, Sierra Leone, Dec. 8–12, 1892, *G. F. Scott Elliot*, no. 4187 *b*.

Has the appearance of a very small delicate form of the widely spread tropical *A. brevifolius*, Sw., but differs in the subacute narrower leaves, the obtuse character of the second glume, and the much less pronounced scabridity of the glumes.

ERAGROSTIS SCOTELLIANA, *Rendle*.

Herba culmo simplici erecto tenui subcompresso sesquipedali, folioso vaginis glabris ore pilosis, carina glandulosa, ligula pilosa, laminis siccis linearibus apice attenuatis, subaristatis, margine convolutis; paniculæ laxæ radiis sparsis patentibus vel ascendentibus, longis, filiformibus; spiculis laxe pedicellatis ovatis, 8-10-floris; radiis et pedicellis scabridis; glumis sterilibus lanceolatis margine pilosis, dorso supra medium scabridis, florentibus ovatis obtusis purpurascentibus, trinerviis, margine pilosis, carina supra basin scabrida; palæis conspicue bicarinatis, carinis supra basin scabridis.

The slender smooth stem is a foot and a half in length, and has an oval or oblong transverse section. The leaf-sheaths are sometimes sparsely hairy on the margins, and have a row ot circular gland-like structures on the back of the keel; the ligule is represented by a fringe of colourless hairs. The dried-up leaves are rolled from the margins. The lax panicle is 7–8 inches long, in one specimen the filiform branches are spreading, in another older one they ascend. The distant ovate spikelets are 8–10-flowered, usually 10, 2 lines long, and have filiform pedicels ¼ inch or more in length. The gland-like structures found on the keels and again on the back of the flowering glumes occur here and there on the branches of the panicle and on the pedicels, especially the latter. The two lower barren glumes are smaller than the fertile, and like these have pilose edges. The fertile glumes are ¾ of a line long, tinged with purple, and scabrid on the upper two-thirds of the keel, with one or a few of the peculiar "glands" near the obtuse apex. The prominently bicarinate paleæ remain for a short time after the fall of the glumes with their backs to the axis; they are about ¾ line long.

Near Regent, Dec. 10, Old Cemetery, Sierra Leone, no. 4114.

RHYTACHNE ROTTBOELLIOIDES, *Desv.*

E descript. in Ham. Prod. Fl. Ind. Occ. p. 12, et Hackelii in Boll. Soc. Broter. iii. (1884), p. 136, t. 2. fig. 2.

Angola and Congo, *fide* Hackel in DC. Monog. Phan. vi. 275.

Sierra Leone, Afzelius in Herb. Mus. Brit.! Alluvial plains, Port Lokko, April, *Scott Elliot*, no. 5737.

On two small Collections of Dried Plants from Tibet. By W. Botting Hemsley, F.R.S., A.L.S.; with an Introductory Note by Lieut.-Gen. R. Strachey, C.S.I., F.R.S., F.L.S.* (Contributed by permission of the Director of the Royal Gardens, Kew.)

[Read 6th April, 1893.]

(Plates IV. & V.)

Captain Bower's expedition traversed Tibet from west to east, starting from Lé in Ladak, in latitude 34° N. and longitude 79° E., and passing into China in latitude 30° N. and longitude 100° E. His route lay on a line about 250 to 300 miles north of the main peaks of the Himalaya, and the point where he entered China, the lowest in this part of the journey, was upwards of 9000 feet above the level of the sea. The greater part of his road, however, was above 14,000 feet and the average was more, probably upwards of 15,000 feet above the sea. The expedition is the first conducted by Englishmen that has traversed Tibet throughout its length; and it is important as fully establishing the general character of the country, as being truly indicated by the Chinese maps, and as being an extremely elevated and rough plateau broken up by a multitude of mountain-ridges, among which are interspersed a vast number of lakes and pools of varying sizes, into which the surface-drainage collects, without forming streams of any magnitude. These features extend from the 80th to the 92nd meridians—to the west of the 80th meridian the drainage collecting into rivers that flow off to the Indus, and to the east of the 92nd meridian the drainage passing away to the eastward into the Bay of Bengal or the China Sea.

The climate of these parts of Tibet is very extreme. The air is very dry, and the sun's power in the rarefied and usually cloudless sky very great. The vegetation is meagre in the last degree; and in the tract that I visited, which being much nearer to the Himalaya than the region through which Capt. Bower passed is no doubt better supplied with moisture, I estimated that not one twentieth part of the surface was covered with vegetation.

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* To this is appended a brief account of some plants, since received at Kew, collected by Mr. W. Woodville Rockhill on his journey in 1892 through Central Tibet, from Mongolia southward to the Tengri Nor and eastward into China.

The comparison of Mr. Thorold's collection of plants with that made by Mr. E. Winterbottom and myself in 1847 will be of considerable interest; and I append an abstract of the portion of our collection made in Tibet. The time during which we were there was little more than a month, and the area we traversed was comparatively limited; but I think the collections were fairly complete. We were, however, rather late in the year, and we may have lost some of the earlier flowering-plants. The total number of flowering-plants collected in Tibet consisted of 41 natural orders—33 exogenous and 8 endogenous; the exogenous genera being 96 with 173 species, and the endogenous genera 24 with 45 species, of which 30 were grasses and sedges. A single fern was found and three or four mosses. The lichens were obtained exclusively, I think, from rocks.

The country in which our collections were made is between the 80th and 82nd meridians, extending from Niti to Manasarowar Lake.—R. STRACHEY.

A full account of Capt. Bower's journey appeared in the 'Geographical Journal' for May 1893, with a route-map on which the altitudes are indicated. With the exception of the western part of Tibet, where General Strachey and the late Dr. Thomas Thomson botanized upwards of forty years ago, and several recent travellers have collected more or less fully, so little is known of the vegetation of the vast elevated mountainous region stretching from the Karakoram range eastward far into China, that I do not hesitate to offer the Society a few particulars concerning two small collections of dried plants presented to Kew within the past year.

SURGEON-CAPTAIN THOROLD'S COLLECTION.

The first of which I intend saying something was made by Surgeon-Captain W. G. Thorold, who accompanied Captain Bower on his memorable journey across Tibet into China. In consequence of Mr. Thorold's sudden recall to India, I am unable to give such precise information on the localities where the plants were collected as I could wish and the Society might desire. In reply to my questions on this point, Mr. Thorold wrote: "The majority of the plants were collected in Tibet west and north of Lhassa; a very few being found north-east of Lhassa, but not one in Chinese Tibet—that is, between Batang and Tachienlu." This collection is a most remarkable one, and unique of its kind; for, assuming that the altitudes given are correct, I believe I am right in stating that no flowering-plants had previously been collected at so high a level as some of these. It is true that General Strachey long ago expressed (Journ. R. Geogr. Soc. xxi. p. 77) his conviction that flowering-plants existed up to 19,000 feet; and Hooker and Thomson ('Flora Indica,' i. p. 220) state that, "though plants may be gathered up to 19,000 feet, vegetation is excessively scanty, and only found by the margins of rills from melting snow." And they continue:—"The flora of these regions includes some plants of great interest, as *Papaver nudicaule*, *Oxygraphis glacialis*, *Ranunculus hyperboreus*, *Taraxacum officinale*, *Delphinium Brunonianum*, and *Berberis ulicina*." Then follows a list of high-level plants, with indications of those observed above 17,000 feet; but as a matter of fact I find no plant actually recorded from a greater altitude than 18,000 feet, either in the introduction or in the body of the work. At p. 227 of the same work the genera *Alsine*, *Draba*, *Androsace*, *Oxytropis*, *Sedum*, *Saxifraga*, and others are said to ascend to 18,000 feet. In the privately printed list of plants collected by Strachey and Winterbottom in Kumaon and Western Tibet, and partly reproduced here, pp. 125 and 126, only two, *Trachypodium Roylei* and *Nepeta tibetica*, are recorded from so great an altitude as 17,500 feet. Dr. T. Thomson ('Travels,' p. 149) mentions that he found an *Arenaria*, a *Stellaria*, and two cruciferous plants at the summit of Lanak Pass, an elevation of 18,100 feet.

Mr. Thorold's collection consists of about 115 species belonging to 69 genera and 28 natural orders. With few exceptions, the specimens, although often limited to a single small plant, are sufficient for identification or description. Captain Bower is reported as having stated that for a period of five months the party never encamped at a lower altitude than 15,000 feet; and throughout the country traversed during those five months not a single tree was seen. But that statement, judging from Mr. Thorold's collection, which was made at altitudes of 15,000 to 19,000 feet, gives no idea of the nature of the vegetation. Not only were there no trees, there were no shrubs, and there were no plants above a foot high, and very few above 3 inches out of the ground. Indeed, as I shall show you presently, many of the specimens are not more than an inch high. I have already mentioned that this collection is a most remarkable one. It is remarkable as representing, so far as Mr. Thorold's manifestly careful investigations went, the entire phanerogamic flora of the region in question. In one of his letters he expressly points out that the collection includes a specimen of every flowering-plant he was able to find. The collection is remarkable, too, for its completeness in another sense. With the permission of the Director of Kew, I am able this evening to exhibit a sample of this wonderful flora; and you will perceive that each specimen is an entire plant, usually with a root very much longer than the top. The three species figured in the two Plates illustrating this paper will give an idea of the plants characteristic of this vegetation.

I will now say a few words respecting the plants generally. A very large proportion of them, probably 85 per cent., are herbaceous perennials having relatively long thick tap-roots, a rosette of leaves lying on the ground, and an inflorescence nestling close in the centre of the rosettes of leaves. Examples of this type of plant are offered by the species of *Saussurea*, *Crepis sorocephala*, and *Pleurospermum stellatum*. I may mention in this connection that *Saussurea tridactyla* is the only flowering-plant recorded from the great altitude of 19,000 feet. It is a relatively tall plant, even at this altitude being nearly six inches high; but it is protected by a very thick woolly covering. Mr. G. A. Gammie, in his report of a botanical tour in Sikkim (see 'Kew Bulletin,' no. 82, p. 313), states that this was the last plant found on the ascent to the Donkia Pass; and he adds that this and *Antennaria muscoides* are supposed by the Tibetans to be the most esteemed of their gods as incense.

There is also an annual or monocarpic element in this alpine flora, and, singularly enough, the Gentianaceæ contribute at least four annual species. I have mentioned that woody plants were almost unrepresented in the collection. *Ephedra Gerardiana* is the only truly woody plant observed. It has a strong subterranean development, but only appeared on the surface of the ground. The only other plant to which I wish to direct special attention is the *Meconopsis horridula*, from an elevation of 15,500 feet. It is a comparatively showy plant, having handsome blue flowers. It was first collected by Sir Joseph Hooker just within Tibet on the borders of Sikkim; and Mr. Franchet, to whom we are indebted for the working out of the exceedingly rich collections made by French missionaries in Eastern Mongolia and Western China, records it from Mongolia; and Mr. Rockhill found it in Central Tibet. It is difficult to connect the very prickly capsule, as a protected fruit, with the conditions under which the plant is found at the present time.

I had almost forgotten the diminutive *Iris* which Mr. Baker has described as a new species. This and *Allium senescens*, a plant widely spread in Tibet, Siberia, and Mongolia, are the only two petaloid monocotyledons.

Let me now proceed to give a few figures in relation to the altitudes and general distribution of the plants constituting the vegetation of this elevated region, the colours of their flowers, and some other particulars.

With regard to elevation, two species are recorded from below 15,000 feet; 14 from between 15,000 and 16,000 feet; 35 from between 16,000 and 17,000 feet; 57 from between 17,000 and 18,000 feet; 5 between 18,000 and 19,000 feet; and one, *Saussurea tridactyla*, to which I have already alluded, from 19,000 feet.

So far as natural orders are concerned, there is not much to be said. With the exception of the Gnetaceæ (*Ephedra*), they are all represented in Britain, and are mostly of world-wide distribution. The predominating orders are:—Compositæ, yielding 21 species; Leguminosæ, 14 species; Gramineæ, 13 species; Cruciferæ, 11 species; and Ranunculaceæ, 8 species.

Coming to genera: about half a dozen are restricted to the Himalayan and Tibetan regions, and the rest are mostly of wide distribution. The genera most numerous in species are *Astragalus, Oxytropis, Saussurea, Ranunculus,* and *Gentiana.* The genera *Astragalus* and *Oxytropis* are so numerous in species, very many of which are not represented by authenticated specimens at Kew, and so difficult, that I have not attempted to work out the species in this collection beyond comparing them with those in the Kew Herbarium. The beautiful alpine genus *Saussurea*, of which there are so many species in the mountains of Northern India and Western China, is represented by no fewer than seven species, two of which I have described as new. But I wish to say with regard to the dozen or so of forms described as new species, they may, some of them at least, prove to be reduced or impoverished conditions of other species. Several that I at first took for new species I eventually referred to others, as the differences were limited to size and habit, evidently due to the local conditions.

The distribution of the species is more interesting; yet, as comparatively little is known of the flora of Central Asia, little reliance should be placed on the figures I have to offer. So far as our present knowledge goes, 27 of the species, excluding the undetermined ones, which may or may not be new, are peculiar to Tibet; 18 are common to Tibet and the Himalayas; 22 extend eastward to Mongolia or China; 20 have a westward extension to Yarkand, Afghanistan, or the Caucasus, and a few of them even to Europe; whilst 14 are found all round the Northern Hemisphere, and two or three extend into the Southern.

With regard to the colours of the flowers of the plants inhabiting this elevated region, Mr. Thorold describes the colours of the flowers of all the plants collected, but not always in such a way as to lead to an easy classification. Leaving the grasses and sedges and a few other plants having quite inconspicuous green or yellowish flowers out of the question, I find that flowers with some infusion of red predominate. They are variously qualified as pinkish, purplish, and so on; but altogether they constitute at least 25 per cent. of the collection. Nevertheless, a deep intense red would appear to be very rare. *Sedum tibeticum* is perhaps the only plant having fully red flowers. Apart from grasses and sedges, in which there is more or less yellow, 25 species are described as having yellow flowers. Thirteen have blue flowers, and some of them of the deepest hue, and one is described as violet. Finally, there are fifteen indicated as white. It is probable, however, that colour has now very little importance in this alpine flora, which is apparently the remains of a former richer vegetation. Insect life, according to Captain Bower, is scarce, though butterflies were seen up to an altitude of 17,600 feet.

I have not had time to study and consider such biological evidence as dried plants offer; but it is clear that some of the perennials produce seed in abundance; and such monocarpic or annual plants as the Gentians maintain their place in the flora by sexual reproduction only. But apart from the evidently monocarpic plants, of which there may be about a dozen in the collection, there is no doubt that almost all of them are produced from seed. Indeed, with the exception of a very few found near streams or in marshy situations, none of the plants increase or spread by vegetative propagation. I should judge that the ground is nowhere matted with vegetation, so that there is practically no struggle, as between plant and plant, for existence; and survival is largely due to seminal productiveness. No doubt such plants as *Saussurea glanduligera, Allium senescens*, and many other of the perennial plants attain a great age, witness their extraordinary root-development.

Captain H. P. Picot's Collection.

Respecting the second collection I have little to say; but it is interesting as showing that the composition of the vegetation is very much the same in such widely distant localities as Lhassa and the Kuen-lun plains, in the extreme north-east of Kashmir or Little Tibet. Captain H. P. Picot, of the Indian Staff Corps, visited this country in 1892 and brought away a few fragments of plants screwed up in a newspaper. These were soaked, pressed, and mounted. There are 25 species, a list of which is appended to this paper. One third of the species are the same as those collected by Dr. Thorold. They were collected at altitudes between 11,500 and 17,000 feet. Excluding some fragments, concerning which no definite opinion could be formed, they are all known plants, though three or four of them had only previously been collected by Dr. Thomson upwards of forty years ago.

In conclusion my thanks are due to my colleagues at Kew for their assistance, more especially to Mr. J. G. Baker, Dr. O. Stapf, and Mr. J. F. Jeffrey. I would also call attention to Mr. C. H. Fitch's careful drawings of the plants figured.

Enumeration of the Plants collected by Mr. Thorold.

1. **Clematis alpina,** *Mill.*—Flowers yellow. Sheltered nooks in hills, at 16,200 ft.

Widely spread in Central Asia from the Ural to North China, near Peking.

2. **Adonis cærulea,** *Maxim.*—Flowers bluish. Wide valleys at 17,200 ft.

North-eastern Tibet and Western Kansuh.

3. **Ranunculus Cymbalariæ,** *Pursh.*—Flowers yellow. Edge of streams at 17,800 ft.

Central and North Asia, eastward to North China, and North and South America.

4. **Ranunculus involucratus,** *Maxim. Fl. Tang.* i. p. 15, t. 22. ff. 7–13.—Flowers yellow. Sandy earth and gravel in valleys at 17,500 ft.

I at first took this to be an undescribed species, not being aware of the existence of Maximowicz's description and figure under the above name. Then, when I came to describe it, I arrived at the conclusion that it was a reduced state of *R. lobatus*, Jacquem.; and I am still of that opinion, but in the absence of ripe fruit I will not presume to decide the point. Maximowicz compares his new species with the very different *Oxygraphis Shaftoana*, Aitch. et Hemsl.*, and makes no mention of *Ranunculus lobatus*.

North-eastern Tibet.

5. **Ranunculus pulchellus**, *C. A. Meyer.*—Flowers yellow. Near water at 17,300 ft.

Afghanistan, alpine Himalaya, Siberia, and Mongolia.

6. **Ranunculus hyperboreus**, *Rottb.*, var. **natans**, *Regel.*—Flowers yellow. Streams at 16,200 ft.

Northern alpine and arctic regions.

7. **Delphinium grandiflorum**, *Linn.*—Flowers blue. Side of slope at 14,800 ft.

Widely spread in the mountains of Northern India, Tibet, Southern Siberia, and Western China.

8. **Delphinium cæruleum**, *Jacquem.*—Flowers purple. Top of pass at 17,800 ft.

Alpine region of the Himalayas from Kumaon to Sikkim.

9. **Meconopsis horridula**, *Hook. f. et Thoms.*—Flowers blue. Water-logged soil in valley close to marsh at 15,500 ft.

Sikkim Himalaya at 14,000 to 17,000 ft., and in Eastern Mongolia.

10. **Hypecoum leptocarpum**, *Hook. f. et Thoms.*—Flowers light violet. Sheltered nullahs at 15,500 ft.

Western Tibet and Sikkim Himalaya.

11. **Corydalis Boweri**, *Hemsl.*

Species pusilla *C. mucroniferæ*, Maxim. valde affinis sed differt floribus majoribus calcari quam lamina longiore.

Herba perennis, cæspitosa, vix sesquipollicaris, radice fusiformi

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* Journ. Linn. Soc., Bot. xix. p. 149, t. 3.

elongata. *Folia* longiuscule petiolata, cum petiolo pollicaria, crassiuscula, ita ut bractea papillosa, semel trisecta et pinnatisecta, lobis oblongo-spathulatis apice seta longiuscula instructis. *Racemi* congesti, pauciflori, bracteis flabellato-multifidis ciliolatis flores fere æquantibus, lobis apice longe 1-setosis. *Flores* flavi, breviter pedicellati, circiter 5 lineas longi; sepala minuta, auriculiformia, paucilobulata; petalum inferius anguste cochleariforme, petala lateralia spathulata, cum superiore alte connata; calcar latum, obtusum, quam lamina longius; adelphiæ staminum infra medium subite dilatatæ, ovarium amplectentes; ovarium glabrum, oblongum, 4-ovulatum, stylo stamina æquanti, stigmate trilobato. *Capsula* ellipsoidea, seminibus rotundato-reniformibus nigris nitidis.

Flowers yellow. Water-logged soil in valley at 15,500 ft.

In spite of the differences indicated, further specimens may prove this to be a form of *C. mucronifera*, Maxim.

12. **Corydalis Hendersonii,** *Hemsl.*

Ad *C. tibeticam*, Hook. f. et Thoms. accedit, differt habitu foliis trisectis, bracteis amplis flabellatis, calcari deorsum attenuato.

Herba perennis, robusta, 2–3 poll. alta, glabra, radice crassa fusiformi, caule simplici vel pauciramoso densissime foliifero basi sæpe foliis vetustis vestito. *Folia* crassiuscula, bipinnatisecta, vel semel trisecta simul bipinnatisecta, 1–1½ poll. longa, segmentis brevissimis obtusis vel minute mucroniferis; petiolus tenuis, dilatatus, laminam æquans vel superans. *Racemi* valde abbreviati, pauciflori, bracteis amplis flabellato-multifidis ciliolatis flores fere æquantibus. *Flores* flavi, breviter pedicellati, circiter 9 lineas longi; sepala minutissima, paucidenticulata, diu persistentia; petalum inferius cochleariforme, petalum superius naviculare, petala lateralia spatulata, cum superiore breviter connata, dorso longitudinaliter alata; calcar fere rectum, laminam æquans; adelphiæ staminum deorsum vix dilatatæ, basi ecaudatæ, ovarium glabrum, oblongum, circiter 10-ovulatum, stylo elongato stamina æquanti. *Capsula* ignota.

Flowers yellow. Sandy gravelly soil in valleys at 17,600 ft.

This species was also collected in Yarkand by Dr. G. Henderson, after whom I have named it, in 1870. In the list of plants published in his book 'Lahore to Yarkand,' it is named *C. tibetica*, Hook. f. et Thoms., though the specimen in the Kew Herbarium is queried. It was only met with just beyond the

Karakoram watershed on the desert plains wherever there was a little shelter and moisture, on Lingzi Thang and at Lak Zung, at 17,000 ft.

13. **Parrya lanuginosa,** *Hook. f. et Thoms.*—Flowers purple. In water-logged stony soil at 17,600 ft.

Western Tibet, in Gugi, at an altitude of 17,500 ft.

14. **Erysimum funiculosum,** *Hook. f. et Thoms.*—Near water in valley at 17,600 ft.

Sikkim Himalaya at 14,000 to 16,000 ft.

15. **Sisymbrium humile,** *C. A. Meyer.*—Flowers white. Sandy, gravelly soil near water at 17,500 ft.

Western Tibet, Siberia, and Arctic regions of North America.

16. **Braya rosea,** *Bunge.*—Flowers purplish white. Muddy, stony soil close to streams at 17,800 ft.

Alpine Himalaya, Altai, and Arctic Siberia.

17. **Braya uniflora,** *Hook. f. et Thoms.*; *Hook. Ic. Plant.* t. 2251.—Flowers white. Sandy, gravelly soil at 17,600 ft.

Western Tibet, in Nubra, at 15,000 to 17,000 ft.

18. **Draba incompta,** *Stev.*—Flowers white. Gravelly soil in valleys at 16,500 ft.

Caucasus, Persia, and Western Tibet.

19. **Draba alpina,** *Linn.*—Flowers yellow. Valley, at 17,600 ft.

Arctic and alpine regions all round the northern hemisphere.

20. **Cochlearia scapiflora,** *Hook. f. et Thoms.*—At 17,800 ft.

Sikkim and Western Tibet to Yarkand, at 15,000 to 18,000 ft.

21. **Christolea crassifolia,** *Camb.*—Flowers white. Sandy, gravelly soil in valleys at 16,800 ft.

Yarkand and Western Tibet at 12,000 to 15,000 ft.

22. **Capsella Thomsoni,** *Hook. f.*—Flowers white. Sandy, gravelly soil near water at 17,500 ft.

Western Tibet at 16,000 to 18,000 ft.

23. **Lepidium capitatum,** *Hook. f. et Thoms.*—Flowers purple with yellow centre. Stony ground close to water at 16,200 ft.

Himalayas from Kumaon to Sikkim, at 10,000 to 14,000 ft. Also collected in Ladak.

24. **Stellaria**, sp.—*S. arenariæ*, Maxim., affinis.—Flowers green. Sandy, gravelly soil near water at 17,500 ft.

25. **Arenaria**, sp.—*A. musciformi*, Wall., affinis.—Flowers white. Sandy, gravelly soil in valleys at 17,500 ft.

26. **Myricaria germanica**, *Desf.*, var. **prostrata**, *Benth. et Hook. f.*—At 17,300 ft.

This very reduced form or species is restricted to the most elevated alpine regions of vegetation of Tibet and the Himalayas, but the species, as limited in the 'Flora of British India,' ranges from Western Europe to Western China.

27. **Thermopsis inflata**, *Camb.*—Flowers yellow. Top of pass in sand at 18,500 ft.

Tibet and Kunawar at elevations of 15,000 to 17,000 ft., and north-west to Kashgar.

28. **Astragalus Hendersonii**, *Baker.*—Flowers purple. Sandy, gravelly soil in valleys at 16,800 ft.

Tibet, in the upper part of the Karakash valley.

29. **Astragalus tribulifolius**, *Benth.*—Flowers purple. Sandy valley at 15,800 ft.

Western Tibet at 14,500 ft.

30. **Astragalus**, sp.—Flowers blue. Top of pass at 18,000 ft.

31. **Astragalus**, sp.—*A. Masenderani*, Bunge, affinis.—Flowers purplish white. Valleys in muddy stony soil at 17,600–17,800 ft.

32. **Astragalus**, sp.—Flowers purple. Sandy, gravelly soil in valleys at 17,500 ft.

33. **Astragalus**, sp.—Flowers purplish blue. Sandy, gravelly soil in valleys at 17,500 ft.

34. **Oxytropis microphylla**, *DC.*—Flowers purplish pink. Valleys at 17,800 ft.

Alpine regions of the Himalaya at elevations of 11,000 to 16,000 ft.

35. **Oxytropis densa**, *Benth.* ?—Flowers purplish red. Sandy, gravelly soil in valleys at 17,500 ft.

Western Tibet at 16,000 to 17,000 ft.

36. **Oxytropis physocarpa**, *Ledeb.*—Flowers purple. Sandy, gravelly sods in valleys at 17,500 ft.

Siberia.

37. **Oxytropis**, sp.—*O. Stracheyanæ*, Benth., affinis.—Flowers pinkish blue. Side of slope at 16,200 ft.

38. **Oxytropis tatarica**, *Jacquem.* — Flowers whitish pink. Sandy soil in wide valley at 17,500 ft.

Western Tibet at 13,000 to 17,000 ft., and in Yarkand.

39. **Oxytropis**, sp.—*O. tataricæ*, Jacquem., affinis.—Flowers purple. Sandy, gravelly soil near water in valleys at 17,500–17,800 ft.

40. **Chamærhodos sabulosa**, *Bunge.*—Flowers white. Sandy soil in valleys at 17,000 ft.

Western Tibet and Altai Mountains to North China.

41. **Potentilla fruticosa**, *Linn.*, var. **pumila**, *Hook. f.*

An exceedingly dwarf form found at very great elevations in the Himalayas. The species inhabits cold temperate and arctic regions all round the northern hemisphere.

42. **Potentilla sericea**, *Linn.*, var. **polychista**, *Lehm.*—Flowers yellow. Sandy earth and gravel in valleys at 17,500 ft.

This variety, which Boissier regarded as a distinct species, inhabits alpine regions of Persia and North India; and the species ranges all round the northern hemisphere.

43. **Sedum tibeticum**, *Hook. f. et Thoms.*, var. **Stracheyi**, *Hook. f.*—Flowers red. Sandy gravelly soil close to water at 17,500 ft.

Western Himalaya and Afghanistan up to 16,000 ft. Also in Yarkand.

44. **Sedum quadrifidum**, *Pall.*—Flowers pink. Earthy soil close to streams in valleys at 17,000 ft.

Arctic and alpine regions of Asia.

45. **Parnassia trinervis**, *Drude.*—Flowers white. Marsh at 15,000 ft.

This is treated as a variety of *P. ovata*, Ledeb., in the 'Flora of British India,' a species widely spread in temperate and alpine regions of the Himalayas, and extending to the Altai mountains.

46. **Saxifraga parva**, *Hemsl.*

S. saginoidei simillima, a qua differt caulibus paucifoliatis,

foliis longe petiolatis, floribus dimidio majoribus, petalis latioribus enerviis.

Herba perennis, dense cæspitosa, 1–2-pollicaris, pilis paucis ferrugineis longissimis vestita, caulibus vel scapis paucifoliatis unifloris. *Folia* alterna, petiolata (radicalia longe petiolata), carnosa, lineari-spathulata, maxima vix pollicaria, integerrima, obtusa, evenia, lamina glabra, petiolo vaginanti. *Flores* flavi, folia vix superantes, 4–5 lineas diametro; calycis lobi subcarnosi, oblongi, obtusi, ciliolati, quam petala paullo breviores; petala spathulata, obtusissima, fere 2 lineas longa; stamina quam petala paullo longiora, filamentis filiformibus; styli brevissimi. *Capsula* ignota.

Flowers yellow. Sides of rivulets at 17,000 ft.

47. **Saxifraga**, sp.—*S. palpebratæ*, Hook. f. et Thoms., affinis. —Flowers yellow. Marsh at 15,000 ft.

48. **Pleurospermum stellatum**, *Benth.*, var. **Lindleyana**, *Clarke*. —Flowers white. Sandy soil in broad valley at 16,400 ft.

Western Himalaya, Karakoram, and Tianschan mountains.

49. **Morina Coulteriana**, *Royle*.—Valleys at 15,500 ft.

Western Himalaya.

50. **Aster tibeticus**, *Hook. f.*—Flower purple with yellow centre. Edges of warm water springs having sulphurous gas bubbling up. Calcareous soil at 17,800 ft.

Western Himalaya and Tibet at 15,000 to 16,000 ft.

51. **Aster Bowerii**, *Hemsl.*

A. flaccido forma minima similis sed caule 2–3-cephalo foliis fere linearibus.

Herba perennis, hispidulo-hirsuta, pollicaris vel sesquipollicaris, radice fusiformi. *Folia* confertissima, sessilia, ima basi dilatata, crassiuscula, linearia vel angustissime spathulata, maxima vix semipollicaris, apice obtusa vel rotundata, untrinque saltem supra medium pilis albis patentibus obsessa. *Capitula* radiata, subsessilia, circiter 1 poll. diametro; involucri bracteæ numerosæ, biseriatæ, hirsutæ, lineares, interiores longiores, acutiores; receptaculum alveolatum. *Flores* radii lilacini, siccitati involuti; flores disci flavi; pappi setæ albæ, scabridæ. *Achænia* matura non visa, parva, pubescentia.

Sandy gravelly soil on hill-sides at 18,000 ft. Flowers light purplish mauve with yellow centre.

52. **Aster molliusculus,** *Wall.*—Flowers purple. Sandy soil, sheltered nooks at 16,000 ft.

Western Himalaya and Tibet, north of Kumaon from 5000 to 15,000 ft.

53. **Anaphalis xylorrhiza,** *Sch.-Bip.*—Flowers white. Rocky outcrops at 15,500 ft.

Kumaon to Sikkim, at 8000 to 17,000 ft.

54. **Anaphalis,** sp.—Flowers green. Sandy gravelly soil near water at 17,500 ft.

55. **Tanacetum tibeticum,** *Hook. f. et Thoms.*—Flowers yellow. Close to water, among stones at 17,000 ft.

Western Tibet, Parang and Lanak passes at 15,000 to 17,000 ft.

56. **Artemisia desertorum,** *Spreng.*—Flowers greenish yellow. Broad valleys at 16,000 ft,

Turkestan, North-western India, and Siberia.

57. **Artemisia,** sp.—*A. minori*, Jacquem., affinis.—At 17,100 ft.

58. **Senecio arnicoides,** *Wall.*, var. **frigida,** *Hook. fil.*—Flowers yellow. Earthy, water-logged soil in wide valleys at 17,000 ft.

This variety had been previously collected in Kunawar and Western Tibet, in Nubra, Ladak, &c., at elevations of from 15,000 to 17,000 ft. The typical form extends eastward to Nepal.

59. **Cremanthodium,** sp.—*C. humili*, Maxim., affine.—Flowers yellow. In water-logged stony soil at 17,600 ft.

60. **Saussurea subulata,** *C. B. Clarke.*—Flowers purple. Close to water at 17,000 ft.

Western Tibet and Yarkand at 15,000 to 18,000 ft.

61. **Saussurea pygmæa,** *Spreng.*—Flowers purple. Top of pass at 17,800 ft.

Tibet and Siberia from Altai eastward to Dahuria.

62. **Saussurea glanduligera,** *Sch.-Bip.*—Flowers purple. Sandy, stony soil in valley at 17,800 ft.

Western Tibet at 14,000 to 16,000 ft.

63. **Saussurea tridactyla**, *Sch.-Bip.*—Flowers white. Hillside at 19,000 ft.

Sikkim Himalaya on the Tibetan frontier at 16,000 to 18,000 ft.

64. **Saussurea sorocephala**, *Hook. f. et Thoms.*—Flowers light purple. Stony soil close to water at 17,000 ft.

Kunawar and Ladak to the Altai Mountains.

65. **Saussurea Aster**, *Hemsl.* (Plate V.)

Species ex affinitate *S. sorocephalæ* foliis lineari-spathulatis glomerulum sessilem capitulorum superantibus stellatim radiantibus.

Herba monocarpica? longe sericeo-pilosa, circiter bipollicaris, radice fusiformi, caule simplici. *Folia* confertissima, sessilia, membranacea, pilosula vel demum nudiuscula et subscariosa, lineari-spathulata vel linearia, maxima vix pollicaria, obtusa, primum pilis rectis longissimis albis sericeis dense obsessa. *Capitula* circiter 40-flora, arctissime conferta, glomerulum circiter sesquipollicem diametro formantia; involucri bracteæ pauciseriatæ, quam flores breviores, membranaceo-scariosæ, ovatæ, oblongæ, vel interiores lineares, acutæ extus plus minusve pilosæ; receptaculi setæ breves. *Flores* purpurei; pappi setæ circiter 10–12, biseriatæ sed exteriores minores, citissimo deciduæ corollam æquantes, longe plumosæ, nigrescentes. *Achænia* matura non visa, brevia, glabra.

Sandy gravelly soil at 17,500 ft.

66. **Saussurea Thoroldi**, *Hemsl.* (Plate IV. figs. 5–9.)

S. sorocephalæ var. ? *glabratæ*, Hook. f., similis, sed foliis crassis setoso-aculeatis involucri bracteis glabris.

Herba monocarpica? subacaulis, glabra, radice fusiformi, caule simplici cum glomerulo capitulorum vix pollicari. *Folia* pauca, patentia, carnosa vel crasse coriacea, angusta, pinnatifida, lobis paucis deltoideis rectis vel leviter deflexis apice aculeatis instructa, obtusa. *Capitula* circiter 12-flora, arcte conferta, glomerulum circiter sesquipollicem diametro formantia; involucri bracteæ circiter 3-seriatæ, quam flores fere dimidio breviores, omnino glabræ, scarioso-coriaceæ, ovatæ vel oblongæ, apice obtusæ vel rotundatæ, induratæ, atro-brunneæ; receptaculi setæ brevissimæ. *Flores* purpurei; pappi setæ 2-seriatæ, exteriores breviores, simplices, interiores circiter 15, longe plumosæ, quam corolla paullo breviores. *Achænia* matura non visa, ut videtur rugulosa.

Sandy soil close to water, at 16,400 ft.

67. **Crepis sorocephala,** *Hemsl.* (Plate IV. figs. 1–4.)

Species insignis habitu *Crepidis glomeratæ,* sed differt foliis carnosis, floribus albis, achæniis oblongo-obovoideis.

Herba subacaulis, monocarpica? radice incrassata fusiformi elongata. *Vaginæ* infra folia circiter 5–7, albæ, membranaceæ, ovatæ, basi latæ. *Folia* pauca, sessilia, carnosa, oblongo-spathulata, maxima semipollicaria, obtusissima, rugosa, supra, infra medium, et subtus parce villosula. *Capitula* numerosa, arcte conferta, brevissime pedunculata, sæpissime 5-flora, bracteis paucis linearibus vel setaceis interspersa; involucri bracteæ sæpissime 5, infra medium connatæ, uniseriatæ, oblongæ vel ovato-oblongæ, circiter 4 lineas longæ, apice obtusissimæ vel rotundatæ, erectæ, extus supra medium præcipue pilis longis albis instructæ; receptaculum planum. *Flores* albi (*Thorold*), circiter semipollicares; pappi setæ numerosissimæ, obscure scabridæ, rubescentes, quam corolla tertio parte breviores. *Achænia* alba, glabra, oblongo-obovoidea, circiter semilineam longa, multistriata.

Sandy gravelly soil at 17,500 feet.

This and *Crepis glomerata,* Benth. et Hook. fil., might be separated generically on account of the uniseriate involucre of united bracts combined with the singular habit.

68. **Crepis,** sp. an var. depauperata *C. glaucæ,* Benth.?—Flowers yellow. Stony wide valleys at 17,200 ft.

69. **Taraxacum officinale,** *Wigg.*, var.?—Flowers yellow. Hillsides at 16,000 ft.

Similar forms, having almost beakless achenes, occur in the Himalayas; but I certainly think it would be more convenient to separate them specifically, though I would not risk increasing synonymy without a critical examination of all the forms referred to this species.

70. **Taraxacum officinale,** *Wigg.*, var.—Flowers yellow. Stony wide valleys at 17,200 ft.

The Dandelion is recorded in the 'Flora of British India' at localities from 1000 to 18,000 ft., and it is now generally distributed in both northern and southern temperate and cold regions.

71. **Primula tibetica,** *Watt.*—Flowers purple. Close to water at 16,200 ft.

Western Tibet north of Kumaon at 15,500 ft., and Eastern Tibet on the Sikkim frontier at 16,000 to 17,000 ft.

72. **Androsace Chamæjasme,** *Host*, var. **coronata,** *Hook. fil.*—Flowers white with yellow centre. Sandy gravelly soil in sheltered spots near water at 17,500 ft.

This variety had previously been collected in Western Tibet at altitudes of 16,000 to 17,000 ft. The species ranges all round the northern hemisphere in cold regions.

73. **Glaux maritima,** *Linn.*—At 16,200 ft.

North temperate and arctic regions in both hemispheres.

74. **Gentiana falcata,** *Turcz.*— Flowers blue. Marsh at 15,000 ft.

Siberia, in the Altai and Baical mountains.

75. **Gentiana squarrosa,** *Ledeb.*—Flowers blue. Banks of dry rivulet on hill-side at 17,200 ft.

Alpine Himalaya, Dahuria, and Siberia to North China.

76. **Gentiana decumbens,** *Linn.*—Flowers greenish white. Sandy soil near water at 15,400 ft.

Baltistan eastward to Lahul and through Siberia to Dahuria and Mongolia.

77. **Gentiana humilis,** *Stev.*—Flowers whitish blue. Close to water at 16,200 ft.

Caucasus to North India, Eastern Siberia, and Dahuria.

78. **Pleurogyne diffusa,** *Maxim.*—Flowers blue. Hill-side close to water at 16,800 ft.

North Tibet, on the northern declivity of the Burchan Budda chain, in thickets of *Myricaria* at 10,200 ft.

79. **Swertia,** sp.—*S. Davidii*, Franch., affinis.—Flowers blue. Valleys at 15,000 ft.

80. **Tretocarya pratensis,** *Maxim.*—Flowers blue. Earthy stony soil close to streams at 18,000 ft.

Western Kansuh at 10,000 ft.

81. **Microula Benthami**, *C. B. Clarke*; *Hook. Ic. Plant.* t. 2257.—Flowers white. Top of pass at 18,000 ft.

Western Tibet at 15,000 to 17,000 ft.

82. **Pedicularis alaschanica**, *Maxim.*, var. **tibetica**, *Maxim.*—Flowers yellow. Broad valley at 16,000 ft.

Eastern Himalaya, Mongolia, and Western Kansuh.

83. **Pedicularis cheilanthifolia**, *Schrenk.*—Flowers purplish white. Earthy water-logged soil in wide valleys at 17,000 ft.

Himalayas, North Tibet, Soongaria, and Western Kansuh.

84. **Nepeta longibracteata**, *Benth.*—Flowers blue. Stony soil in old water-course at 17,400 ft.

Western Himalaya and Tibet at 14,000 to 17,000 ft.

85. **Dracocephalum heterophyllum**, *Benth.*?—Flowers white. Hill-sides at 17,700 ft.

This species inhabits Western Tibet and Turkestan at 13,000 to 16,000 ft., and has also been found in Eastern Mongolia.

86. **Polygonum sibiricum**, *Laxm.*—Flowers green. Salt-impregnated soil near salt lake at 16,300 ft.

Western Himalaya and Tibet to Western China, and northward into Arctic Siberia.

87. **Stellera Chamæjasme**, *Linn.*—Flowers green. Sandy valleys at 15,000 ft.

Caucasus to the mountains of North India and Central Asia to Mongolia.

88. **Urtica hyperborea**, *Jacquem.*—Flowers greenish white. Rocky hill, amongst stones at 16,200 ft.

Eastern and Western Tibet at 12,000 to 17,500 ft.

89. **Ephedra Gerardiana**, *Wall.*—Flowers yellow. Salt-impregnated soil close to salt lake, at 16,500 ft.

This is united with *E. vulgaris*, Rich., in the 'Flora of British India,' which thus limited extends from Europe to the mountains of North India and Central Asia.

90. **Iris (§ Apogon) Thoroldi**, *Baker*.

Ad *I. humilem*, Bieb., magis accedit: differt caulibus dense cæspitosis, foliorum vetustorum reliquis copiosis valide fibrosis, foliis firmioribus multo brevioribus, floribus minoribus sulphureis, perianthii segmentis exterioribus limbo parvo obovato ungue duplo breviore.

Fibri radicales multi, graciles, cylindrici. Folia viridia, anguste linearia, 2–3 poll. longa, 1 lin. lata, marginibus nervisque incrassatis. Caulis brevissimus, uniflorus. Spathæ valvæ lineares, deorsum membranaceæ, sursum herbaceæ. Perianthii tubus 14 lin. longus; limbus vix pollicaris, pallide luteus; segmenta exteriora 3 lin. lata, limbo reflexo ungue ascendente 2–3plo breviore; segmenta interiora oblanceolata, erecta, quam exteriora vix breviora. Styli 6-7 lin. longi, appendicibus parvis.

Top of the pass, at 17,800 ft.

A well-marked new species, belonging to the group of beardless Irises with a produced perianth-tube. Its other nearest neighbours are *I. Rossii*, Baker, of Corea and Northern China, and *I. Ludwigii*, Maxim., a plant of the Altai Mountains.

91. **Allium senescens**, *Linn.*, var.—Flowers pink. Rocky hill among stones at 16,200 ft.

Southern European Russia through Siberia to Dahuria and Eastern Mongolia.

92. **Juncus membranaceus**, *Royle.*—Flowers white. Close to water, at 16,200 ft.

Himalayas from Kashmir to Sikhim at 6000 to 13,000 ft.

93. **Triglochin palustre**, *Linn.*—Close to water at 16,200 ft.

Western Europe and North Africa to India and China, and in North America.

94. **Carex stenophylla**, *Wahlenb.*—Close to water, at 16,200 ft.

South-eastern Europe to Dahuria and North China.

95. **Carex Moorcroftii**, *Falconer.*—Sandy gravelly soil at 17,600 ft.

Tibet at 14,000 to 17,000 ft.

96. **Trisetum subspicatum**, *Beauv.*—At 16,500 ft.

Very widely spread in temperate and polar regions both in the northern and southern hemispheres.

97. **Poa nemoralis**, *Linn.*—Sheltered valley at 17,000 ft.

All round the northern hemisphere.

98. **Poa alpina**, *Linn.*—Close to water at 16,200 ft.

All round the northern hemisphere.

99. **Poa alpina**, *Linn.*, forma **nana.**—In sandy gravelly soil, at 18,000 ft. (no. 26), at 16,400 ft. (no. 103).

100. **Elymus sibiricus**, *Linn.*—Close to water at 16,200 ft.

North India, Central and Northern Asia, eastward to the Sitka Islands.

101. **Elymus dasystachys**, *Trin.*—Sandy plain at 16,000 ft., and valleys at 17,000 ft.

Siberia, chiefly in the Altai and Baical mountains, and eastward to Mongolia and North China.

102. **Pennisetum flaccidum**, *Griseb.*

Afghanistan, North-west India, and Tibet to Mongolia and North China.

103. **Stipa purpurea**, *Griseb. Gesamm. Abhandl., Gram. Hochasiens*, p. 300.—Syn. Lasiagrostis tremula, *Ruprecht, Sert. Thianschan.* p. 35.—16,500 ft.

Distributed from the Thianshan Mts. and South-east Kashmir to East Tibet: Lake Rupshu, at 15,000 feet, *Lance*!; "Tibet. occ.," probably near the Lanak Pass, between 15,000 and 17,000 feet, *T. Thomson*!; province of Gnari Khorsum, at Poti, 17,000 feet, *Schlagintweit*, Cat. 7016!; Bhomtso Mt., up to nearly 18,000 feet, *J. D. Hooker*!; Thianshan, S.E. of Chatyr-Kul, between 11,000 and 12,000 feet, *Osten-Sacken*!

104. **Stipa** (§ **Lasiagrostis**) **Hookeri**, *Stapf.*

Affinis *S. splendenti*, Trin. (*Lasiagrostis splendens*, Kunth), sed robustior, spiculis majoribus, glumis fertilibus longe bifidis, antheris nudis.

Gramen perenne. *Rhizoma* ut turiones cataphyllis ovatis obtusis firmis prominenter striatis imbricatim vestitum. *Culmus* floriferus ac innovationes basi vaginis vetustis firmis vestitus, glaberrimus, lævis, strictus, cum panicula 1–1½ ped. altus. *Folia innovationum* vagina lævissima, primo arcte involuta, demum plus minusve aperta, ligula brevissima graciliter denseque fimbriata, lamina convoluta longe setaceo-attenuata, glauca, stricta, 4–10 poll. longa, dorso ecarinata, tenuiter striata, asperula vel

lævi, facie profunde et multi-sulcata in costulis asperula; *caulina* longe vaginata, summum fere ad paniculæ basin, vagina lævi striata, in infimis laxa, lamina abbreviata, summi panicula breviore, cæterum ut in innovationibus. *Panicula* angusta subcontracta, 4–6 poll. longa, ramulis pedicellisque brevissimis vel ad 1 lin. longis asperulis. *Glumæ vacuæ* subæquilongæ, lanceolatæ, acutæ, tenues, 3–3½ lin. longæ, glabræ; *fertilis* lanceolata, vix 3 lin. longa, apice ad ⅓ bifida, lobis setaceo-acuminatis, inter eos aristata, 7-nervis, tota longe et patule pilosa, arista vix torta, geniculata, asperula, 4–5 lin. longa. *Palea* lanceolata, gluma fertili paulo brevior, ut ea longe et patule pilosa. *Antheræ* apice nudæ. *Lodiculæ* 3, oblique ovato-lanceolatæ, liberæ. *Styli* subnulli. *Stigmata* ovario æquilonga.

Sheltered nullahs near water, 14,800 feet (no. 124).

The same plant was collected by Sir Joseph Hooker in Eastern Tibet, at 16,000 feet.

105. **Calamagrostis holciformis,** *Jaub. et Spach.*

Tibet and Sikkim at great elevations.

106. **Diplachne Thoroldi,** *Stapf.*

Affinis *Diplachnæ serotinæ*, Link, foliis caulinis paucioribus, minus distincte distiche patentibus, in vaginis superne vel in ore quidem longiuscule pilosis, glumis florentibus exaristatis pilosis.

Rhizoma repens ut turiones dense cataphyllis stramineis ovatis brevibus prominenter striatis vel eorum residuis vestitum. *Culmus* erectus cum panicula 12–16 poll. altus, lævis, ad ½ vaginatus. *Folia* circa 5–6 cum quoque culmo, 3 basalia vaginis laxe et fere ad eandem altitudinem (1–2 poll.) vaginantibus, sequens magis remotum, summum vagina longissima ad 2–4 poll. vel tota longitudine exserta, vaginis inferioribus patule pilosis, demum glabratis, superioribus in ore et in marginibus superne tantum pilosis; ligula ½ lin. longa, truncata, lacerato-ciliata; lamina glauca, in foliis infimis et in summo brevi 1–1½ poll. longa, rarius longiore, in intermediis 1½–4½ poll. longa, e basi 1–1½ lin. lata longissime attenuata, apice fere setacea, in infimis plana, in cæteris involuta, utrinque tenuiter multistriata, glabra vel in infimis sparse pilosa. *Panicula* angusta, 2–4 poll. longa, ramis ad 1–1½ lin. vel infimo remoto ad 3 lin. nudis primo rachin adpressis, deinde patulis vel subreflexis, spiculis brevissime pedicellatis, pedicellis lævibus, 3-floris, flore 4 imperfecto addito, 3–4 lin. longis. *Glumæ vacuæ* tenues, pallidæ vel violaceæ,

inferior 1½ lin. longa, oblongo-lanceolata, obtusiuscula, uninervis, superior 2 lin. longa obtusa vel erosula, trinervis, sparse pilis longis patulis obsita; *florens* oblongo-lanceolata, 2 lin. longa, saturate glauco-violacea, apice obtusiuscula minute denticulata et ciliolata, trinervis, nervo medio haud vel brevissime excurrente, patule pilosa. *Palea* vix brevior acuta, sparse pilosa. *Lodiculæ* truncatæ, obtuse lobulatæ. *Antheræ* 1 lin. longæ. *Ovarium* glabrum, stylis paulo brevioribus, stigmatibus aspergilliformibus.

Sandy soil in valleys, 15,800 ft. (no. 120).

D. serotina has been referred by Mertens and Koch, Grisebach and others to *Molinia*, and although it does not answer exactly to the type on which the genus *Diplachne* was founded by Beauvois, i. e. *D. fascicularis*, Beauv., a North-American species, I prefer to leave it in that genus following the authority of the authors of the 'Genera Plantarum,' of Parlatore and of Hackel, and consequently I also refer the new species to the same genus.

107. **Atropis distans**, *Griseb. in Ledeb. Fl. Ross.* iv. p. 388, forma *nana.*

Wide valleys, 17,000 ft. (no. 78); close to water, 16,200 ft. (no. 88), 16,500 ft. (no. 111).

Var. **convoluta**, *Trautv. in Act. Hort. Petrop.* i. p. 282.—Syn. A. convoluta, *Griseb. in Ledeb. Fl. Ross.* iv. p. 389, forma *nana.*

Close to water, 16,200 ft.

The first form differs from the typical *Atropis distans*, as we usually find it in Europe, only by its dwarfness, the smaller specimens being 2–3 inches high with panicles ½ inch long and broad. The variety *convoluta* is likewise represented by dwarf specimens about 4 inches high, but they agree otherwise perfectly with the form of *Atropis distans* which prevails in the North-western Himalaya and which is identical with the plant described by Grisebach under the name of *A. convoluta.* This variety extends from Tibet to the Altai and westward to South Russia.

108. **Festuca ovina**, *Linn.*, var. **valesiaca**, *Koch*; cf. *Hackel in Boissier, Fl. Orient.* v. p. 618.

At 16,500 ft. (no. 110).

A common grass in the higher parts of the Himalaya from the Afghanistan frontier to Sikkim, here from 12,000 ft. ascending to 17,000 ft. (Donkiah Pass, *J. D. Hooker*).

109. **Agropyrum Thoroldianum,** *Oliver in Hook. Ic. Pl.* t. 2262. —At 16,500 ft.

Not previously represented in the Kew Herbarium.

Enumeration of the Plants collected on the Kuen-lun Plains at about 17,000 feet by Captain H. P. Picot*.

Clematis orientalis, *Linn.*, var. **tangutica,** *Maxim.*
Persia to Maudshuria and North China.

Berberis ulicina, *Hook. f. et Thoms.*
Previously collected by Dr. Thomson only in Nubra, at 14,000 to 16,000 ft.

Christolea crassifolia, *Camb.* *
Western Tibet to Lhassa.

Malcolmia africana, *Linn.*
Mediterranean region to North-west India.

Myricaria germanica, *Linn.* *
Europe to Western China.

Astragalus, sp.

Potentilla Salessowii, *Steph.*
North-west India and Siberia.

Potentilla fruticosa, *Linn.* *
Cold temperate and arctic regions all round the northern hemisphere.

Potentilla bifurca, *Linn.*
Caucasus and Taurus to Siberia and Mongolia.

Potentilla sericea, *Linn.* *
All round the northern hemisphere.

Sedum crenulatum, *Hook. f. et Thoms.*
Kumaon and Sikkim at 12,000 to 18,000 ft.

Chrysanthemum Richteria, *Benth.*
Tibet and Soongaria.

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* Those followed by a star were also collected by Mr. Thorold.

Tanacetum tibeticum, *Hook. f. et Thoms.* *
Western Tibet at 15,000 to 17,000 ft. Previously collected only by Dr. T. Thomson and Mr. Thorold.

Artemisia, sp.?

Taraxacum officinale, *Wigg.* *
Generally dispersed in temperate and cold regions.

Statice, sp.—insufficient for determination.

Primula sibirica, *Jacq.*
North India, Siberia, and China.

Androsace Chamæjasme, *Linn.* *
Cold regions all round the northern hemisphere.

Lindelofia Benthami, *Hook. f.*
Kashmir and Western Tibet, at 11,000 to 15,000 ft.

Pedicularis dolichorrhiza, *Schrenk.*
Turkestan and North India to Mongolia.

Allium blandum, *Wall.*
Kumaon to Nepal, at 13,000 to 17,000 ft.

Allium, sp.—*A. Jacquemontii,* Reg., affinis.

Triglochin maritimum, *Linn.*
Sea-coasts and salt marshes all round the northern hemisphere.

Kobresia Royleana, *Boeck.*
Kumaon to Sikkim.

Elymus sibiricus, *Linn.* *
North India, Central and Northern Asia eastward to the Sitka Islands.

Elymus dasystachys, *Trin.*, forma **tomentella.***
Siberia, Mongolia, and China.

ABSTRACT of Tibetan portion of Collection of Plants made by T. E. Winterbottom and R. Strachey in 1847.

EXOGENÆ.

Genera.	Species.	
1. *Ranunculaceæ.*		
1. Clematis	1	
2. Anemone	3	
3. Thalictrum	2	
4. Adonis	1	
5. Ranunculus	6	
6. Isopyrum	1	
7. Delphinium	2	
8. Aconitum	1	
		—17
2. *Fumariaceæ.*		
1. Corydalis	3	
		— 3
3. *Cruciferæ.*		
1. Parrya	2	
2. Cheiranthus	1	
3. Arabis	1	
4. Alyssum	1	
5. Draba	4	
6. Cochlearia	1	
7. Sisymbrium	2	
8. Erysimum	1	
9. Christolea	1	
10. Braya	1	
11. Lepidium	1	
12. Thlaspi	1	
13. Iberidella	1	
14. Crambe	1	
15. Chorispora	1	
		—20
4. *Violaceæ.*		
1. Viola	1	
		— 1
5. *Caryophylleæ.*		
1. Silene	1	
2. Lychnis	2	
3. Stellaria	1	
4. Arenaria	3	
5. Thylacospermum	1	
		— 8
6. *Tamariscineæ.*		
1. Myricaria	2	
		— 2
7. *Geraniaceæ.*		
1. Biebersteinia	1	
2. Geranium	1	
		— 2
8. *Leguminosæ.*		
1. Thermopsis	1	
2. Caragana	2	
3. Gueldenstædtia	1	
4. Astragalus	3	
5. Oxytropis	4	
6. Stracheya	1	
7. Cicer	1	
		—13
9. *Rosaceæ.*		
1. Potentilla	7	
2. Chamærhodos	1	
		— 8
10. *Saxifrageæ.*		
1. Saxifraga	5	
2. Parnassia	1	
		— 6
11. *Crassulaceæ.*		
1. Sedum	5	
2. Sempervivum	1	
		— 6
12. *Halorageæ.*		
1. Hippuris	1	
		— 1
13. *Onagraceæ.*		
1. Epilobium	2	
		— 2
14. *Umbelliferæ.*		
1. Trachydium	1	
2. Pleurospermum	1	
		— 2
15. *Caprifoliaceæ.*		
1. Lonicera	1	
		— 1
16. *Compositæ.*		
1. Aster	2	
2. Erigeron	1	
3. Leontopodium	1	
4. Anaphalis	2	
5. Allardia	2	
6. Tanacetum	3	
7. Artemisia	4	
8. Senecio	3	
9. Werneria	1	
10. Saussurea	5	
11. Crepis	1	
12. Taraxacum	1	
13. Lactuca	1	
		—27
17. *Campanulaceæ.*		
1. Campanula	1	
		— 1
18. *Primulaceæ.*		
1. Primula	5	
2. Androsace	1	
		— 6
19. *Gentianaceæ.*		
1. Gentiana	6	
2. Pleurogyne	1	
		— 7
20. *Boragineæ.*		
1. Lindelofia	1	
2. Eritrichium	2	
3. Microula	1	
4. Onosma	1	
		— 5

Genera.	Species.
21. *Solanaceæ.*	
1. Physochlaina	1
	— 1
22. *Scrophularineæ.*	
1. Veronica	1
2. Pedicularis	4
	— 5
23. *Selagineæ.*	
1. Lagotis	1
	— 1
24. *Labiatæ.*	
1. Elsholtzia	1
2. Thymus	1
3. Nepeta	4
4. Dracocephalum	1
5. Marrubium	1
6. Lamium	1
	— 9
25. *Chenopodiaceæ.*	
1. Eurotia	1
2. Axyris	1
3. Microgynæcium	1
4. Salsola	1
	— 4

Genera.	Species.
26. *Polygonaceæ.*	
1. Polygonum	4
2. Rheum	1
	— 5
27. *Elæagnaceæ.*	
1. Hippophaë	1
	— 1
28. *Euphorbiaceæ.*	
1. Euphorbia	2
	— 2
29. *Urticaceæ.*	
1. Urtica	1
	— 1
30. *Cupuliferæ.*	
1. Betula	1
	— 1
31. *Salicineæ.*	
1. Salix	1
	— 1
32. *Gnetaceæ.*	
1. Ephedra	1
	— 1
33. *Coniferæ.*	
1. Juniperus	3
	— 3

ENDOGENÆ.

1. *Hæmodoraceæ.*	
1. Aletris	1
	— 1
2. *Irideæ.*	
1. Iris	1
	— 1
3. *Liliaceæ.*	
1. Polygonatum	1
2. Allium	4
3. Lloydia	1
	— 6
4. *Juncaceæ.*	
1. Juncus	3
	— 3
5. *Alismaceæ.*	
1. Triglochin	2
	— 2
6. *Naiadaceæ.*	
1. Potamogeton	2
	— 2

7. *Cyperaceæ.*	
1. Blysmus	1
2. Elyna	1
3. Trilepis	1
4. Carex	6
	— 9
8. *Gramineæ.*	
1. Piptatherum	2
2. Lasiagrostis	1
3. Stipa	1
4. Deyeuxia	1
5. Deschampsia	1
6. Trisetum	2
7. Poa	4
8. Schœnodorus	1
9. Festuca	2
10. Agropyrum	2
11. Elymus	2
12. Hordeum	2
	—21

CRYPTOGAMÆ.

1. *Equisetaceæ.*	
1. Equisetum	1
	— 1
2. *Filices.*	
1. Cystopteris	1
	— 1
3. *Musci.*	
1. Distichium	1
2. Bryum	2
3. Hypnum	1
	— 4

4. *Lichenes.*	
1. Lecidea	4
2. Cladonia	1
3. Urceolaria	1
4. Parmelia	10
5. Cetraria	1
6. Evernia	1
	—18

R. STRACHEY.

Thorold's Tibet Plants.

Siberia.		Tibet only.	Tibet and N. India.	Eastward.	Westward.	Wide, including America.
	Ranunculaceæ.					
*	Clematis alpina	...	...	China	Ural	
	Adonis cærulea	...	...	China		
*	Ranunculus Cymbalariæ ...	...	...	...	...	*
	„ involucratus ...	*				
*	„ pulchellus	...	...	Mongolia	Afgh.	
*	„ hyperboreus ...	...	...	...	...	*
*	Delphinium grandiflorum ...	...	*	China		
	„ cæruleum	...	*			
	8					
	Papaveraceæ.					
	Meconopsis horridula.........	...	*	Mongolia		
	Hypecoum leptocarpum	...	*			
	2					
	Fumariaceæ.					
	Corydalis Boweri	*				
	„ Hendersonii	...	...	...	Yarkand	
	2					
	Cruciferæ.					
	Parrya lanuginosa	*				
	Erysimum funiculosum	...	*			
*	Sisymbrium humile	...	...	...	...	*
*	Braya rosea	...	...	*	*	
	„ uniflora	*				
	Draba incompta	...	...	...	Caucasus	
*	„ alpina	...	...	...	...	*
	Cochlearia scapiflora	...	*	...	Yarkand	
	Christolea crassifolia	...	...	...	Yarkand	
	Capsella Thomsoni	*				
	Lepidium capitatum	...	*			
	11					
	Caryophylleæ.					
	Stellaria sp.					
	Arenaria sp.					
	2					
	Tamariscineæ.					
	Myricaria germanica	...	...	China	Europe	
	1					
	Leguminosæ.					
	Thermopsis inflata	*				
	Astragalus Hendersonii	*				
	„ tribulifolius	*				
	„ sp.					
	„ sp.					
	„ sp.					
	„ sp.					
	„ sp.					
8		8	7			4

THOROLD'S TIBET PLANTS (*continued*).

Siberia.		Tibet only.	Tibet and N. India.	East-ward.	West-ward.	Wide, including America.
8		8	7	7	8	4
	Leguminosæ (cont.)					
	Oxytropis microphylla	...	*			
	,, densa	*				
*	,, physocarpa					
	,, sp.					
	,, tatarica	...	...	...	Yarkand	
	,, sp.					
	14					
	Rosaceæ.					
*	Chamærhodos sabulosa	...	...	China		
	Potentilla fruticosa	...	...	...	...	*
	,, sericea	...	...	...	...	*
	3					
	Crassulaceæ.					
	Sedum tibeticum	...	...	...	Yarkand Afgh.	
*	,, quadrifidum	...	*			
	2					
	Saxifragaceæ.					
*	Parnassia trinervis	...	*			
	Saxifraga parva	*				
	,, sp.					
	3					
	Umbelliferæ.					
	Pleurospermum stellatum	*				
	1					
	Dipsacaceæ.					
	Morina Coulteriana	...	...	...	W. Himal.	
	1					
	Compositæ.					
	Aster tibeticus	...	*			
	,, Thoroldii	*				
	,, molliusculus	...	*			
	Erigeron sp.					
	Anaphalis xylorrhiza	...	*			
	,, sp.					
	Tanacetum tibeticum	*				
*	Artemisia desertorum	...	*			
	,, sp.					
	Senecio arnicoides	...	*			
	Cremanthodium sp.					
	Saussurea subulata	...	...	...	Yarkand	
*	,, pygmæa	...	...	Dahuria		
	,, glanduligera	*				
	,, tridactyla	...	*			
*	,, sorocephala					
	,, Aster	*				
	,, Thoroldi	*				
	Crepis sorocephala	*				
	,, sp.					
	Taraxacum officinale	...	...	...	...	*
15	21	17	16	9	12	7

THOROLD'S TIBET PLANTS (*continued*).

Siberia.		Tibet only.	Tibet and N. India.	East-ward.	West-ward.	Wide, including America.
15		17	16	9	12	7
	Primulaceæ.					
	Primula tibetica	*				
	Androsace Chamæjasme	...	...	...	...	*
	Glaux maritima	...	...	...	...	*
	3					
	Gentianaceæ.					
*	Gentiana falcata					
	,, squarrosa	...	...	China		
	,, decumbens	...	...	Mongolia	Baltistan	
	,, humilis	...	...	Dahuria	Caucasus	
	Pleurogyne diffusa	*				
	Swertia sp.					
	6					
	Boragineæ.					
	Tretocarya pratensis	...	...	China		
	Microula Benthami	*				
	2					
	Scrophularineæ.					
	Pedicularis cheilanthifolia	...	...	China		
	,, alaschanica	...	...	China		
	2					
	Labiatæ.					
	Nepeta longebracteata	*				
	Dracocephalum heterophyllum	...	...	Mongolia		
	2					
	Polygoneæ.					
*	Polygonum sibiricum	...	...	China		
	1					
	Thymelæaceæ.					
	Stellera Chamæjasme	...	...	...	Caucasus	
	1					
	Urticaceæ.					
	Urtica hyperborea	*				
	1					
	Gnetaceæ.					
*	Ephedra Gerardiana	...	...	...	Europe	
	1					
	Irideæ.					
	Iris Thoroldi	*				
	1					
	Liliaceæ.					
	Allium senescens	...	...	Mongolia	E. Europe	
	1					
18		23	16	18	17	9

THOROLD'S TIBET PLANTS (*continued*).

Siberia.		Tibet only.	Tibet and N. India.	East-ward.	West-ward.	Wide, including America.
18		23	16	18	17	9
	Juncaceæ.					
	Juncus membranaceus.........	...	*			
	1					
	Alismaceæ.					
	Triglochin palustre	...	...	...	...	*
	1					
	Cyperaceæ.					
	Carex stenophylla	...	...	China	Europe	
	,, Moorcroftii	*				
	2					
	Gramineæ.					
	Trisetum subspicatum.........	...	...	...	...	*
	Poa nemoralis	...	...	...	...	*
	,, alpina	...	...	...	...	*
	Elymus sibiricus	...	...	Sitka		
*	,, dasystachys............	...	...	China		
	Pennisetum flaccidum.........	...	...	China	Afgh.	
*	Stipa purpurea..................					
	,, Hookeri	*				
	Calamagrostis holciformis ...	...	*			
	Diplachne Thoroldi	*				
*	Atropis distans	...	...	...	E. Europe	
	Festuca ovina	...	...	...	...	*
	Agropyrum Thoroldianum...	*				
	13					
21		27	18	22	20	14

EXPLANATION OF THE PLATES.

PLATE IV.

Fig. 1. A plant of *Crepis sorocephala*, Hemsl., natural size; 2, a capitulum from the cluster of capitula; 3, a flower; 4, a bristle of the pappus. 5, a plant of *Saussurea Thoroldii*, Hemsl., natural size, also having densely clustered capitula; 6, a capitulum; 7, a flower; 8, one of the outer shorter bristles of the pappus; 9, stamens. All enlarged.

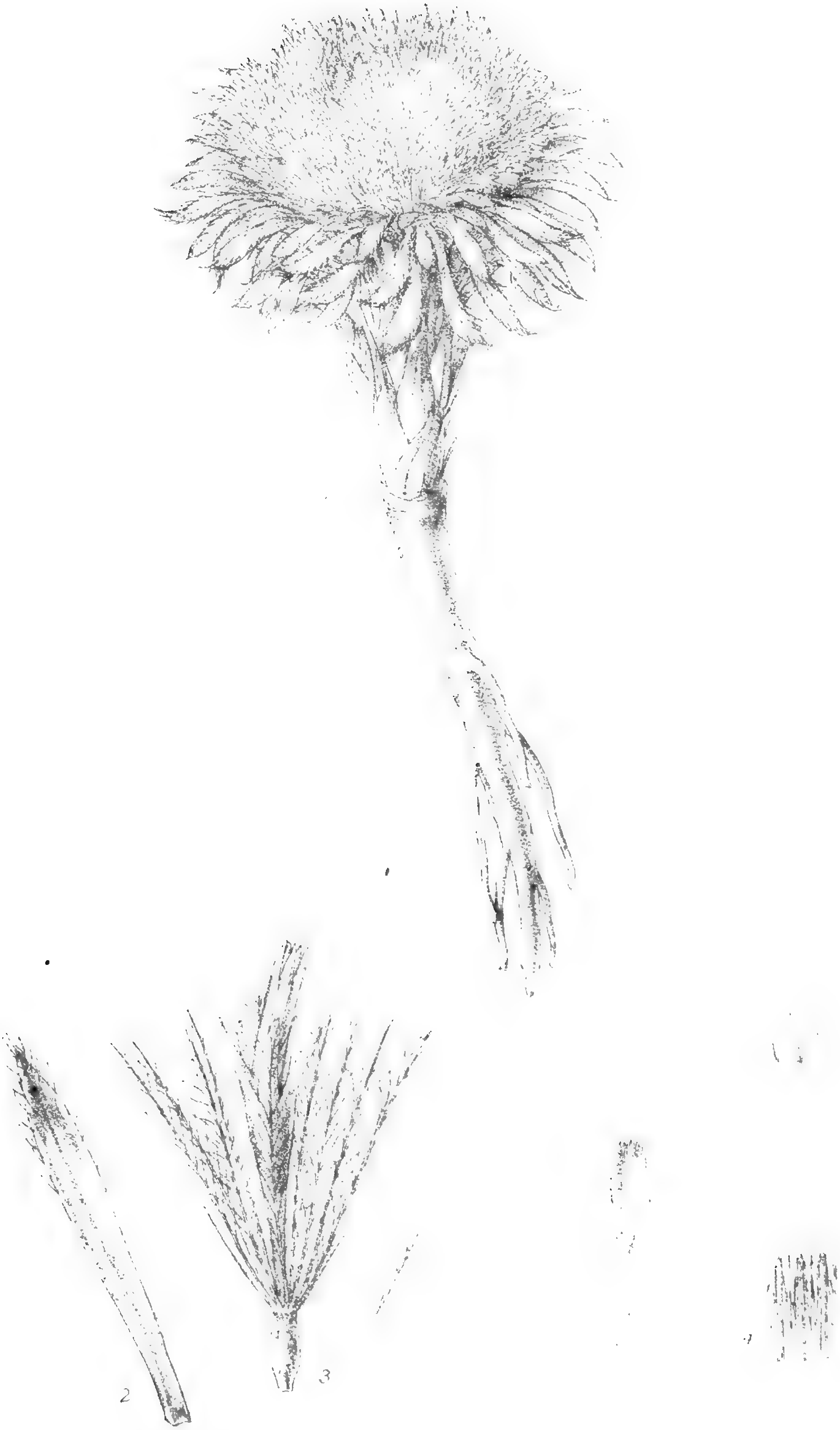
PLATE V.

Fig. 1. A plant of *Saussurea Aster*, Hemsl., natural size, having densely clustered capitula; 2, a leaf; 3, a flower; 4, stamens; 5, stigma and upper portion of style. All enlarged.

C.H.Fitch del et lith.

J.N.Fitch imp.

1-4 CREPIS SOROCEPHALA, *Hemsl.*
5-9 SAUSSUREA THOROLDII, *Hemsl.*



C.H. Fitch del. et lith.

J.N. Fitch imp.

SAUSSUREA ASTER, *Hemsley*.

MR. WOODVILLE ROCKHILL'S CENTRAL TIBET PLANTS.

Collected in 1892.

SINCE the foregoing paper on Dr. Thorold's Tibet plants and Captain Picot's Kuen-lun plants was read, the Kew Herbarium has been enriched, through the kindness of Professor C. S. Sargent, Director of the Arnold Arboretum, Harvard University, U.S.A., by the collection of dried plants made by Mr. W. W. Rockhill on his last journey in Tibet, in 1892. It is unnecessary to say much concerning this gentleman's travels in China, Mongolia, and Tibet. His first journey is described and illustrated in his 'Land of the Lamas,' published in 1891; and his last journey, on which the plants enumerated below were collected, is the subject of a work already, I believe, in the printer's hands. It will be remembered that Mr. Rockhill was last year (1893) awarded the Patron's or Victoria Medal of the Royal Geographical Society. I had prepared a brief outline of Mr. Rockhill's route from a condensed report of his account of his journey read before the Royal Geographical Society in March of the past year; but on the very day of going to press I have received a prefatory note from him, which is much more to the purpose, and may follow here:—

"The object I had in view when making the little collection of plants, which, through Professor Ch. S. Sargent's kindness, has been examined and classified by Mr. Hemsley, of the Royal Gardens at Kew, was to give some idea of the flora of the country between the Kuen-lun range to the north and the inhabited regions of Tibet adjacent to the Tengri Nor on the south. This region has an average altitude of 15,000 feet above sea-level along the route followed by me in 1892, and had not, prior to my visit, been explored.

"The route followed in 1879 by Col. Przewalsky, when travelling towards Lhasa, which was nearly parallel to the last that I took, differed considerably as regards the configuration of the country from mine; and consequently I anticipated that notable differences in the flora along the two roads would be discovered.

"I traversed this country in the months of May, June, July, and part of August, and heavy snowstorms and nearly daily frosts occurred during this period, though the thermometer rose more than once to 70° F., and even 83° on one occasion in the shade at 2 P.M. The mean temperature from the 17th of May, when we entered the mountainous region to the south of the Ts'aidan, to the 11th of August, when we descended to below the Timber line (13,500 feet above sea-level) on the Ramachú, where I ceased collecting plants, except such as the natives pointed out to me as being used by them either as food or medicinally, is shown in the following table :—

1892.	7 A.M.	2 P.M.	7 P.M.
May 17 to 31 ...	+37°·5 F.	+54°·6 F.	+37°·3 F.
June	+35°·7	+55°·9	+38°·3
July	+43°·0	+54°·6	+44°·2
Aug. 1 to 11 ...	+40°·6	+61°·5	+47°·3

"Nearly the whole of the region traversed in this interval was of sandstone formation, the predominating colour of which was bright red. The water was invariably brackish, and in many cases undrinkable; the soil everywhere sandy, or covered with a rather fine gravel, and occasionally a little clay. The grasses grew in bunches, nowhere forming a sod, except around the rare pools of pure water fed by the melting snows we occasionally passed.

"I was careful to collect all the flowering plants I saw along my route, and the barrenness of this region may be judged by the very small number I have brought home with me.

"The only edible plant we found in this country was a species of onion (*Allium senescens*)*, which grew in the sand in great quantities at altitudes higher than 15,000 ft. above sea-level, though we looked for it in vain below this level.

"I may here remark that the rhubarb plant, which I found growing in enormous quantities on the north and north-eastern slopes of mountains on the Ich'u, Lench'u, and other feeders of the Jyama-nu ch'u, thrived at an altitude above sea-level ranging from 12,000 to 13,500 ft. I note this fact as Col. Przewalsky (Mongolia, ii. p. 84) says that this plant rarely flourishes at an elevation of more than 10,000 ft. above the level of the sea.

"For further details concerning the habitats of the various plants I brought home with me I beg to refer to the annexed enumeration." W. WOODVILLE ROCKHILL.

This is an exceedingly interesting collection, especially when examined in connection with Mr. Thorold's; the plants for the greater part being of the same habit and diminutive size. More than half of them, however, are different species; and most of them had previously only been collected by Przewalsky, from whose specimens the lamented Maximowicz described them. Several, it will be seen, too, were previously only known from the extreme western part of Tibet. In all cases where the species are different from Thorold's their general distribution is given. The localities, altitudes, and geographical positions were supplied by Mr. Rockhill.

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* There was no specimen of this plant in Mr. Rockhill's collection.—W. B. H.

Mr. Rockhill also brought home leaves of the famous "white sandalwood tree" of Kumbum, *Syringa villosa*, Vahl, which he erroneously refers to as *Philadelphus coronarius*, Linn., in his 'Land of the Lamas.'

ENUMERATION of the Plants collected by Mr. W. Woodville Rockhill.

1. **Clematis graveolens**, *Lindl.*—Flowers light yellow. Pochu valley; very abundant at 14,000 ft. Lat. N. 31° 45′, long. E. 94° 45′. Aug. 14, 1892.

Western Himalaya at 6000 to 11,000 ft., Tibet and Western China.

This form is the same as that named *C. orientalis* var. *tangutica* by Maximowicz, but if the two are maintained as independent species it is better referred here.

2. **Anemone imbricata**, *Maxim. Fl. Tangut.* i. p. 8, t. 22. ff. 1–6.—Foot-hills of Dangla mountains, N.W. extremity of range at 16,500 ft. Lat. N. 33° 40′, long. E. 90° 35′. June 27, 1892.

Previously collected only by Przewalsky on the extreme Upper Yangtsekiang in Tibet.

3. **Ranunculus tricuspis**, *Maxim. Fl. Tangut.* i. p. 12; *Enum. Pl. Mongol.* i. p. 16, t. 4. ff. 17–27.—Valley of Murus; valley bottom at 15,640 ft. Lat. N. 33° 44′, long. E. 91° 18′. June 23, 1892.

Mongolia.

4. **Delphinium grandiflorum**, *Linn.*—Kechu valley at 12,700 ft. Lat. N. 31° 25′, long. E. 96° 28′. Aug. 22, 1892.

On river-bottom; fine forest-growth, mostly pines (?), on hill-sides; fine grass.

5. **Delphinium Pylzowii**, *Maxim. in Mél. Biol.* ix. p. 709; *Fl. Tangut.* i. p. 21, t. 3.—Dangchu valley, river-bottom of gravel and clay; good fodder, at 14,500 ft. Lat. N. 32° 12′, long. E. 92° 12′. July 23, 1892.

Mongolia.

6. **Meconopsis horridula**, *Hook. f. et Thoms.*—Plateau west of Dangla mountains at 16,350 ft. Lat. N. 32° 51′, long. E. 89° 44′. July 3, 1892.

Sandy soil, some clay.

7. **Corydalis Hendersonii**, *Hemsl.*—Basin of Murus. Extreme head of valley on foot-hills of Dangla mountains at 16,340 ft. Lat. N. 33° 43′, long. E. 90° 50′. June 25, 1892.

Sandstone.

See description of this species in Thorold's list at p. 109.

8. **Parrya exscapa**, *Ledeb.*—Basin of Murus. Extreme head of valley, on foot-hills of Dangla mountains, sandstone, at 16,340 ft. Lat. N. 33° 43′, long. E. 90° 50′. June 25, 1892.

Altai mountains and Western Tibet.

9. **Arabis**, sp.? Insufficient for determination.—Valley of Tsacha-tsang-bo-chu at 14,700 ft. Lat. N. 32° 13′, long. E. 90° 14′. July 6, 1892.

10. **Erysimum Chamæphyton**, *Maxim. Fl. Tangut.* i. p. 63, t. 28. ff. 1–10.—Hill-slope two miles north of Murus river (headwaters of Yangtsekiang); sandy soil, some clay, at 14,750 ft. Lat. N. 33° 53′, long. E. 91° 31′. June 21, 1892.

Basin of Murus in lateral valley, sandstone, at 15,700 ft. Lat. N. 33° 45′, long. E. 91° 05′. June 24, 1892.

North-eastern Tibet.

11. **Eutrema Przewalskii**, *Maxim. Fl. Tangut.* i. p. 68, t. 28. ff. 11–23.—Basin of Murus, in lateral valley, sandstone, at 15,700 ft. Lat. N. 33° 45′, long. E. 91° 05′. June 24, 1892.

North-eastern Tibet.

12. **Myricaria prostrata**, *Hook. f. et Thoms. in Benth. et Hook. f. Gen. Pl.* i. p. 161.—Upper Naichi gol valley near river at 12,130 ft. Lat. N. 35° 52′, long. E. 93° 49′. May 21, 1892.

Called "aura kashim" by the Mongols. First plant in flower seen on journey.

I have followed Maximowicz in restoring this form to specific rank. It is restricted to the elevated alpine regions of the Himalayas and Tibet. See Maximowicz (Fl. Tangut. p. 95, t. 31), where it is fully described and figured. In Hooker's Fl. Brit. Ind. i. p. 250, it is treated as a variety of *M. germanica*.

13. **Gueldenstædtia ?**, insufficient for determination.—Gela, on Ramongchu at 12,670 ft. Lat. N. 31° 40′, long. E. 94° 36′. Aug. 13, 1892.

Fine crops of barley and turnips near by.

14. **Astragalus** or **Oxytropis**, sp. ? Material insufficient to determine the genus.—Toktomai-ulan-muren at 14,340 ft. Lat. N. 34° 09′, long. E. 91° 30′. June 20, 1892.

Sandy soil.

15. **Astragalus** or **Oxytropis**, sp. ? Material insufficient to determine the genus with certainty.—Valley of Murus, head-waters Yangtsekiang, at 14,900 ft. Lat. N. 33° 45′, long. E. 91° 20′. June 22, 1892.

16. **Potentilla fruticosa**, *Linn.*, var. **pumila**, *Hook. f.*—Plateau west of Dangla mountains at 16,350 ft. Lat. N. 32° 51′, long. E. 89° 44′. July 3, 1892.

Sandy soil, some clay.

17. **Potentilla anserina**, *Linn.*—Plateau west of Dangla mountains; sandy, some clay, at 16,220 ft. Lat. N. 33° 09′, long. E. 89° 38′. July 2, 1892.

This is widely spread in the temperate and cold regions of both the northern and southern hemispheres.

18. **Potentilla nivea**, *Linn.*—Kechu valley; on river-bottom at 12,700 ft. Lat. N. 31° 25′, long. E. 96° 28′. Aug. 22, 1892.

Fine forest-growth, mostly pines (?) on hill-sides; fine grass.

Alpine and Arctic regions of the northern hemisphere.

19. **Sedum algidum**, *Ledeb.*, var. **tanguticum**, *Maxim.*—Camp north of Tsacha-tsang-bo-chu; sandy soil at 15,650 ft. Lat. N. 32° 28′, long. E. 90° 03′. July 5, 1892.

The species is a native of the Altai regions of Siberia; the variety was described from specimens from north-western Kansuh.

20. **Aster tibeticus**, *Hook. f.*—Valley of Murus, valley-bottom at 15,640 ft. Lat. N. 33° 44′, long. E. 91° 18′. June 23, 1892.

Western Tibet and Kashmir at altitudes of 14,000 to 16,000 ft.

21. **Inula?** Material insufficient for determination.—Foot-hills of Dangla mountains, north-west extremity of range at 16,500 ft. Lat. N. 33° 40′, long. E. 90° 35′. June 27, 1892.

22. **Leontopodium alpinum**, *Cass.*, var.—Bank Chilchang-tso (Lake Glenelg). Hill-side; limestone and red sandstone; lake salt, at 16,000 ft. Lat. N. 33° 27′, long. E. 90° 10′. June 30, 1892.

Alps of Europe, through Central Asia and North India to China, ascending in the Himalayas to nearly 18,000 ft. The variety collected by Mr. Rockhill is a very elegant little plant about three inches high with remarkably spathulate leaves.

23. **Leontopodium Stracheyi**, *C. B. Clarke in Herb. Kew.* (L. alpinum, *Cass.*, var. Stracheyi, *Hook. f.*).—Ruchu valley, in river-bottom, at 12,100 ft. Lat. N. 31° 10′, long. E. 95° 12′. Aug. 16, 1892.

Fine crops of barley and turnips now ripe. Also a little wheat.

This Western Tibet and Himalayan plant is so easily distinguished from the other forms that it may well be accorded specific rank. It ranges from Kumaon to Nepal.

24. **Anaphalis mucronata**, *C. B. Clarke.*—Basin of Dangchu, right bank affluent. Clay and sand-gravel, at 15,180 ft. Lat. N. 32° 20′, long. E. 92° 08′. July 21, 1892.

This form is united with *A. nubigena*, DC., in the 'Flora of British India.' It is only found at great altitudes in the Himalayas and Tibet.

25. **Antennaria nana**, *Hook. f. et Thoms.*—Valley of Murus, head-waters Yangtsekiang, at 14,900 ft. Lat. N. 33° 45′, long. E. 91° 20′. June 22, 1892.

Western Tibet in the Nubra and Shayuk valleys at 12,000 to 14,000 ft.

26. **Saussurea tangutica**, *Maxim. in Mél. Biol.* xi. p. 247.—Near summit of Gam (or Angti) la at 15,600 ft. Lat. N. 30° 40′, long. E. 98° 13′. Sept. 4, 1892.

Tangut and Northern Tibet.

The leaves are infused and used by the natives as a tonic. Called in Tibetan Sha-pó gong-t'ag. It is said to grow only on the west side of this mountain. The Chinese call it "snow lotus" (*Hsuch lien*).

27. **Taraxacum palustre,** *DC.*—Valley of Murus, valley-bottom at 15,640 ft. Lat. N. 33° 44′, long. E. 91° 18′. June 23, 1892.

This is usually regarded as a variety of the almost ubiquitous *T. officinale.*

28. **Cyananthus incanus,** *Hook. f. et Thoms.*, var. **leiocalyx,** *Franch. in Morot's Journ. de Bot.* i. 1887, p. 279.—Kechu valley at 12,700 ft. Lat. N. 31° 25′, long. E. 96° 28′. Aug. 22, 1892.

On river-bottom. Fine forest-growth, mostly pines (?) on hillsides; fine grass.

A Himalayan species, of which this is a naked-calyx variety, also found in Yunnan. The typical form inhabits alpine localities at 12,000 to 16,000 ft.

29. **Androsace tapeta,** *Maxim. in Mél. Biol.* xii. p. 754.—Valley of Murus, head-waters Yangtsekiang, at 14,900 ft. Lat. N. 33° 45′, long. E. 91° 20′. June 22, 1892.

Kansuh and Szechuen, in Western China.

30. **Androsace villosa,** *Linn.*, var. **latifolia,** *Ledeb.*—Valley of Murus, valley-bottom at 15,640 ft. Lat. N. 33° 44′, long. E. 91° 18′. June 23, 1892.

This species is widely dispersed from Asia Minor through Central Asia, North Asia, and the mountains of North India.

31. **Gentiana Rockhillii,** *Hemsl.*, n. sp.

Species *G. aristatæ*, Maxim., similis sed minor strictior floribus fere cylindricis angustissimis.

Annua, erecta, simplex vel pauciramosa, 1–2-pollicaris, glaberrima. *Folia* subscariosa, lineari-subulata, vere conduplicata, 3–4 lineas longa, apice breviter aristata, basi semiamplexicaulia, suberecta, cauli fere appressa. *Flores* cærulei, terminales, solitarii, subsessiles, circiter 9 lineas longi; calyx subscariosus, corollæ tubum æquans, dentibus lineari-subulatis; corollæ sursum leviter dilatatæ, lobi breves, oblongi, vix acuti, erecti, conniventes, intermediis brevioribus albis tenuissimis, fauce nuda; stamina cum pistillo omnino inclusa; styli brevissimi, stigmatibus capitatis.

Kechu valley at 12,700 ft. Lat. N. 31° 25′, long. E. 96° 28′. Aug. 22, 1892.

On river-bottom. Fine forest-growth, mostly pines (?), on hill-sides; fine grass.

32. **Tretocarya sikkimensis**, *Oliver, in Hook. Ic. Plant.* t. 2255.—Basin of Suchu valley, north side, Drayalamo pass, at 14,600 ft. Lat. N. 31° 52′, long. E. 93° 17′. Aug. 2, 1892.

Limestone; fine grass; flowers blue, very abundant.

Sikkim Himalaya at 11,500 ft., and Western China near Tachienlu. Mr. Rockhill's specimen is much smaller than the others and nearly glabrous.

33. **Pedicularis Oederi**, *Vahl* (P. versicolor, *Wahlenb.*).—Valley of Murus, valley-bottom at 15,640 ft. Lat. N. 33° 44′, long. E. 91° 18′. June 23, 1892.

Alpine and Arctic regions of Europe, Asia, and America.

34. **Pedicularis Przewalskii**, *Maxim. in Mél. Biol.* x. p. 84, et xii. p. 787, n. 2. fig. 2.—Large state. Basin of Suchu, valley north side, Drayalamo pass, at 14,000 ft. Lat. N. 31° 52′, long. E. 93° 17′. Aug. 2, 1892.

Limestone; fine grass; flowers blue, very abundant.

Eastern Himalaya, Tibet, and China.

35. **Lagotis brachystachya**, *Maxim. in Mél. Biol.* xi. p. 300.—Hill-slope 2 miles N. of Murus river, head-waters Yangtsekiang, at 14,750 ft. Lat. N. 33° 53′, long. E. 91° 31′. June 21, 1892.

Sandy soil, some clay.

Kansuh.

36. **Polygonum Bistorta**, *Linn.*—Pochu valley at 14,000 ft. Lat. N. 31° 45′, long. E. 94° 45. Aug. 14, 1892.

Temperate and cold regions of Europe, Asia, and America.

37. **Polygonum viviparum**, *Linn.*—Pochu valley at 14,000 ft. Lat. N. 31° 45′, long. E. 94° 45′. Aug. 14, 1892.

The seeds are parched and ground and eaten mixed with barley-meal (*tsamba*). Tibetans call it *ranpa* or *ramba*.

Temperate and Arctic regions of Europe, Asia, and America.

38. **Polygonum bistortioides**, *Boiss.*—Ramachu valley, hill-side, at 12,800 ft. Lat. N. 31° 48′, long. E. 94° 28′. Aug. 12, 1892.

Used by the natives for food like *P. viviparum*.

This species or variety is found in Asia Minor and Persia. Although very distinct from ordinary *P. Bistorta*, Boissier (Flora Orientalis, iv. p. 1028) subsequently united it with that species.

39. **Iris Thoroldi**, *Baker, ante*, p. 118, *et Hook. Ic. Plant. ined.*—Sharakuyi-gol, hill-slope at 13,800 ft. Lat. N. 35° 50′, long. E. 93° 27′. May 29, 1892.

Described from specimens collected by Dr. Thorold at an altitude of 17,800 ft. Mr. Rockhill's specimens furnish better flowers.

40. **Tulipa** (§ **Orithyia**) *sp. aff.* T. eduli, *Baker.*—Sharakuyi-gol, hill-slope at 13,800 feet. Lat. N. 35° 50′, long. E. 93° 27′. May 29, 1892.

Tulipa edulis is a native of Japan, and Mr. Rockhill's one flower is insufficient for satisfactory identification.

41. **Carex Moorcroftii**, *Boott.*—Hill-slope two miles north of Murus river, head-waters Yangtsekiang, at 14,750 ft. Lat. N. 35° 53′, long. E. 91° 31′. Sandy soil, some clay. June 21, 1892.

Yarkand and Western Himalaya.

42. **Kobresia Sargentiana**, *Hemsl.*, n. sp.

K. schœnoidei valde affinis sed bracteis latissimis spicam fere omnino involventibus late scariosis subtruncatis simul emarginatis.

Hill-slope two miles N. of Murus river, head-waters Yangtsekiang, at 14,750 ft. Lat. N. 33° 53′, long. E. 91° 31′. Sandy soil, some clay. June 21, 1892.

43. **Miscanthus sinensis**, *Anderss.*—Near top of Feiyuehkuan pass, S.W. of Yachoufu, in West Szechuen, at 3583 ft. Oct. 11, 1892.

China, from Japan and Korea to Hongkong and Canton, Luchu and Bonin Islands, Tonquin, Borneo, and Celebes.

44. **Stipa**, insufficient for determination.—Hill-slope two miles N. of Murus river, head-waters Yangtsekiang, at 14,750 ft. Lat. N. 33° 53′, long. E. 91° 31′. Sandy soil, some clay. June 21, 1892.

45. **Calamagrostis**, sp.—Near top of Feiyuehkuan pass, S.W. of Yachoufu, in West Szechuen, at 3583 ft. Oct. 11, 1892.

46. **Festuca ovina**, *Linn.*?—Hill-slope two miles north of Murus river, head-waters Yangtsekiang, at 14,750 ft. Lat. N. 33° 53′, long. E. 91° 31′. Sandy soil, some clay. June 21, 1892.

Europe, N. Africa, Siberia, Himalaya, N. & S. America, and mountains of Australasia. Mr. Rockhill's specimen is a mere fragment.

47. **Usnea barbata**, *Fries.*—Valley of Pontramo, east of Batang, at 12,600 ft. Lat. N. 29° 59′, long. E. 99° 42′. Sept. 19, 1892.

Sometimes 30 feet long. Hangs only on the oaks called "green oaks" (ching kang) by the Chinese. This oak is called by the French missionaries "chêne à feuilles de houx."

All over the world in temperate and tropical regions.

Recent Botanical Exploration in Southern Persia, being the substance of a Letter from Mr. J. Bornmüller to Dr. Otto Stapf. (Communicated by the Secretary.)

[Read 16th February, 1893.]

Mr. J. Bornmüller, a botanist known from his collections in Asia Minor, went, late in 1891, to S. Persia with the intention of exploring the high mountains of Kirman, which were botanically a *terra incognita*. He reached the province of Kirman early in May of last year, and visited first Kuh Sirdsh and Kuh Jupar. As it was still too early in the season for exploring the high alpine region, he repeated his excursions to Kuh Jupar, from which point his narrative begins.

Mr. J. Bornmüller brought his exploring tour in the province of Kirman to a successful conclusion. The following is a short summary of his excursions after his first visit to Kuh Jupar.

He visited Kuh Jupar again in the second week of June, when he reached an elevation of 3850 m. (12,644 English feet), but was unable to get to the very top on account of the excessive steepness of the rocks along the ridge. He encamped for six days at 3000 m. (9842 feet). In the beginning of July he started for Kuh Lalesar and Kuh Hezar, which, like Jupar, had never been visited before by a botanist.

Kuh Lalesar is S.W. of Kuh Jupar, Kuh Hezar S. of it; they rise from level or hilly, generally desert, land to 3900 and 4900 m. (12,793 feet; 16,073 feet). Bornmüller succeeded in reaching the culminating peaks of both mountains. The general character of the vegetation is the same in Kuh Jupar, Kuh Lalesar, and Kuh Hezar; and it appears to agree perfectly with that of equal elevations in South-west Persia, whilst the more Indian elements, which are found even as far as Western Beluchistan, seem to be absent. The plains and lower valleys are covered chiefly with a halophytic vegetation, which becomes sometimes very scanty, partly also with masses of *Glycyrrhiza*, *Prosopis*, *Sophora alopecuroides*, and other plants, which prefer a deeper and more clayey soil and occupy usually land which was once in cultivation but is now deserted. Stony hills and gravelly plains abound more especially in wormwoods, *Stellera*, *Zygophyllum eurypterum*, *Scorzonera tortuosissima*, *Anabasis*, and other Salsolaceæ, and occasionally in *Rheum Ribes*. So far the vegetation of the "Biaban" of Kirman agrees perfectly with the character it assumes in the deserts of Central and North Persia. The slopes of the mountains are sprinkled with a scanty "jengeli" vegetation consisting of scattered shrubs or trees of *Ficus carica* (to 2900 m.; 9514 feet), various species of *Amygdalus*, *Colutea persica*, *Daphne acuminata*, *Lonicera nummulariæfolia* (to 2800 m.; 9186 feet), *Cratægus Azarolus*, *Cotoneaster nummularia*, *Acer canescens* (to 3200 m.; 10,498 feet), *Pistacia mutica*, *Ephedra*, *Rhamnus*, &c.; whilst the banks of rivers and torrents are sometimes bordered by thickets of willows and tamarisks, sometimes of *Berberis* (to 3600 m.), *Rosa lacerans* (?) (to 3700 m.; 12,139 feet), and *Rubus sanctus*.

Quercus persica, which forms forest S.W. of Shiraz, and *Celtis transcaucasica*, which is very characteristic of the higher and moister valleys of South-west Persia, were not met with by Bornmüller on those mountains. On the other hand, he found *Juniperus excelsa* in a valley on Kuh Lalesar up to 3400 m. (11,155 feet). The average limit for shrubs lies on Kuh Hezar a little above 3600 m. (11,811 feet). A dwarf *Ribes* only was gathered as high as 4500 m. Bornmüller found Kuh Hezar very dry, and less rich in vegetation than Kuh Lalesar and Kuh Jupar. But even on Kuh Lalesar, where he met with snowfields 4 m. deep (13 feet) in the middle of July, the vegetation consisted almost entirely of species which were mere alpine representatives of the xerophilous types of the lower region. The only high-mountain plants of a more northern character were, apart from the *Ribes* mentioned above, gathered in swampy meadows. Bornmüller mentions particularly a *Primula*, evidently *P. auriculata*, Pall., which is very common on all three mountains, from 3000–3800 m. (9842–12,467 feet), a small-flowered *Parnassia* (*P. subacaulis*, Kar. & Kir. ?), a very fine *Pedicularis*, and a dwarf annual *Gentiana* (*G. minutissima*, Boiss. ?). Very characteristic of the steep rocks were the beautiful cushions of *Dionysia*. The usual fruit-trees were the apricot, plum, apple, pear, walnut, almond, and a variety of *Elæagnus angustifolia* with edible fruit. They all bore very well and freely even at Lalesar, at 3010 m. (9873 feet), except the almond-trees, which were mostly sterile. The walnut-tree sometimes attains enormous dimensions. The plane, which is planted frequently, forms very fine trees even at 2600 m. (8531 feet), but it does not reach the 3000 m. (9842 feet) line. At Chehar Tag, S.W. of Kuh Hezar, at 3000 m., the wheat harvest was in operation on the 7th of August.

Bornmüller left Kirman for Shiraz on the 16th of September. He went by way of Mashiz and Saïdabad to Niris. The country was generally desert and very rich in Salsolaceæ. The hilly parts along the Kuh Paris only were covered with woody vegetation, but of a distinct desert character, whilst *Pistacia mutica* and *Daphne acuminata* were observed in a pass at 2350 m. (7724 feet), and in the mountains E. of Niris, where also *Acer canescens* and, for the first time also, *Celtis transcaucasica* were found. The low country along the south-east shore of the Niris lake yielded numerous Salsolaceæ in a fruiting state. But the mountains S. of it abounded in tree- and shrub-vegetation between 1540 m. (5051 feet) and 1800 m. (5905 feet); and on the 9th of October Bornmüller passed for several hours through a fine wood of *Pistacia mutica* with *Acer*, *Amygdalus*, *Populus euphratica*, *Ephedra foliata*, and a few patches of *Nerium* and *Myrtus*. He crossed this range and reached Shiraz by way of Servistan, where, however, no *Cupressus*—as the name seems to indicate ("Serv," *Cupressus*)—was seen. Bornmüller intended to leave Shiraz at the end of November for Bushir, whence he wished to go either to Maskat or to Basra. In the spring he will start for Shuster and then try to proceed through the western Zagros to Hamadan.

Revision of the Genus *Nipadites*, Bowerb.

By A. B. Rendle, M.A., B.Sc., F.L.S.

[Read 1st June, 1893.]

(Plates VI. & VII.)

In the 'Philosophical Transactions' for 1757 (p. 396) Dr. James Parsons gives an account of some fossil fruits and other bodies found in the island of Sheppey by Edward Jacobs, who also subsequently published an account of them as an Appendix to his 'Plantæ Favershamienses' (1777). Of Parsons's fruits, the only ones bearing any resemblance to *Nipadites* are figs. 1 and 3 on tab. xv., which, he says, seem to be figs petrified when hard and green.

In 1784 Burtin, in his 'Oryctographie de Bruxelles,' describes as coco-nuts some large fossil fruits from the Middle Eocene at Woluwe near Brussels. Numerous specimens have since been brought from the same beds; they are as large as coco-nuts, but broader and more ovate.

In 1785 James Douglas published 'A Dissertation on the Antiquity of the Earth,' and on p. 25 refers to the Sheppey fruits, one of which, the property of Sir Joseph Banks, he figures (t. v.) and describes as "a species of almond . . . . remarkable in the opinion of the most intelligent persons as bearing no analogy in size to any recent specimens of this nut discoverable in any quarter of the globe."

In 1804 Parkinson ('Organic Remains,' p. 458) mentions the same and similar fossils, which, he says, may perhaps be referred to the genus *Cocos*. In plate vii. he figures two specimens: that represented in figs. 1–3 "was originally in the possession of Sir Joseph Banks, by whom it was presented to the British Museum;" while the subject of figs. 4 and 5 "was added to the collection in the British Museum by Mr. Douglas, by whom it is figured and described in his ingenious essay on the antiquity of the earth." Plate vi. fig. 6 is probably the cast of the interior of a fruit of the same species, and figs. 5 and 7 the surface and section of an unripe specimen.

Adolphe Brongniart, in his 'Prodrome' (1828), was the first to give the fossils specific names; Burtin's is cited as *Cocos Burtini*, and Parkinson's as *C. Parkinsonis*. He also includes a third species, "*C. Faujasii*, Faujas, Ann. du Mus. i. p. 445, t. 29."

It is impossible to say what Faujas's fruit was, probably not a *Nipadites*; Jussieu, Desfontaines, Lamarck, and Thouin, who saw specimens, noticed a great resemblance to fruits of the Areca Palm. Brongniart also includes among Monocotyledons of unknown family a monotypic genus of his own, *Pandanocarpum*, "very common in the isle of Sheppey." From the description (p. 135), his *P. oblongum* might be our *Nipadites umbonatus* or *N. lanceolatus*, or perhaps a collective species including all the more elongated fruits. He says it has the greatest analogy with the fruits of *Pandanus*, and scarcely doubts its belonging to this or a closely allied genus.

In the 'Lethea Geognostica' (1837), a mere bibliographical work, Bronn substitutes *Cocites* for *Cocos*; while Endlicher ('Genera Plantarum,' p. 257) calls it *Burtinia*, a new genus of fossil Palms. Brongniart's *Pandanocarpum* Endlicher takes up (*ib.* p. 244), but definitely locates at the end of Pandaneæ as "Pandanea fossilis," immediately after *Phytelephas* and *Nipa*, which are "genera Pandaneis affinia."

The genus *Nipadites* was founded by Bowerbank in 1840, when appeared the first and only published part of his 'History of the Fossil Fruits and Seeds of the London Clay.' He describes thirteen species, one of which, *N. Parkinsonis*, is Brongniart's *Cocos Parkinsonis*; while he suggests that *N. umbonatus* may be *Pandanocarpum oblongum*, Brongn. The author shows reason for rejecting the name *Pandanocarpum* in favour of *Nipadites*, which emphasizes the relation of the fossils to the recent genus *Nipa*. So near, in fact, is this relation, that one is tempted to follow Ettingshausen, who, in a list in the 'Proceedings of the Royal Society,' xxiv. p. 393, reduces all the species to *Nipa*. The only consideration which leads me to keep up the palæontological suffix is the uncertainty which must always attach to the specific diagnosis of fossils based, as it often necessarily is, on material which would be deemed quite inadequate in the case of recent plants.

As Bowerbank points out, the fruits of *Nipadites* are never aggregated into several seeded portions, as in *Pandanus*; but closely resemble those of *Nipa fruticans*, a dwarf palm of somewhat doubtful affinity, frequenting the brackish estuaries and littoral marshes of India and Malaya as far as Borneo, New Guinea, and the Philippines. Both are drupes with a thin epicarp, fibrous mesocarp, and somewhat indurated endocarp.

In the recent fruits, just beneath the epicarp is a dense layer of thin branching longitudinal fibres interspersed with a few thicker, then a looser spongy tissue with thicker fibres running lengthwise and also protruding radially from the endocarp. This structure is best seen at the angles where the mesocarp is thickest; on the broader surfaces the mesocarp is often very thin and the spongy layer absent. I have been able to make out a similar arrangement in many of the fossil fruits.

Bowerbank did not recognize the hard endocarp; but though often the fibrous coat only is perceptible, an innermost more resistant layer can sometimes be seen. In the specimen figured (Pl. VII. fig. C), *e* indicates the dense endocarp from which the fibres are seen radiating outwards. The single seed is replaced by mineral matter; and on the surface of the cast may be found remains of the fibrous testa.

The names *Cocos* and *Cocites*, implying affinity with the modern coco-nut, are undesirable, as there is no indication in the fossil, by pores or otherwise, of the presence of three carpels.

Subsequent workers have shown, and Bowerbank himself seems to have realized, that he made too many species. Ad. Brongniart, in the 'Tableau,' while recognizing that his *Pandanocarpum* and *Cocos Burtini* belong to *Nipadites*, at the same time points out that some of Bowerbank's species are founded on too slight differences, which may be individual variations or the result of the degree of maturity of the fruit or its position in the inflorescence.

In the diagnosis of species it is important to remember that in the modern *Nipa fruticans* the fruits are densely packed in a spherical head, and hence not only is there considerable variety in the number of sides and the development of the angles, but, as many fruits never reach maturity, all stages of abortion may be found, especially near the base of the head, compressed and distorted by the growth of the ripening drupes. There seems no reason to doubt that the fossils were borne in a similar way, as a corresponding variety in shape is evident in one and the same species.

Any one who will look at a head of *Nipa* fruits will see at once how several species might be described from it. I have seen a number of unripe or abortive fruits taken from a head kindly sent by Mr. Ridley from Singapore; and a comparison with

Bowerbank's figures will show that some of his names, *Nipadites clavatus* for instance, might be accounted for in this way. I have seen no fossils at all like ripe fruits of *Nipa fruticans*, which has always the broad, often flattened or even incurved apex with a central umbo; and I might point out that the shape of the upper part of the fruit, whether rounded, obtuse, or pointed, is a valuable character for diagnosis, as it is not influenced by compression by surrounding fruits, the top portion being quite free.

In his 'Synopsis' (1845) and 'Genera et Species Plantarum Fossilium' (1850), Unger follows Bowerbank, and quotes his thirteen species of *Nipadites* under the Order Pandaneæ, while under Palmeæ he cites Endlicher's *Burtinia*. Ettingshausen, on the other hand, in the 'Sitzungsber. Akad. Wiss. Wien' (1852), viii., reduces eleven to a single species, which he calls *Nipadites Bowerbankii*, while the remaining two, *N. semiteres* and *N. pyramidalis*, he unites as *N. semiteres*, but in a list published in the Proc. Roy. Soc. 1879, he rejects *N. Bowerbankii*, making seven of the eleven species formerly included therein synonymous with his *Nipa Burtini*, restoring two others, and reducing two more to a single species. He, moreover, calls them all *Nipa*.

In the Ann. Sci. Nat. (Botany), 1862, Saporta describes, from the lower lignite near Belcodême and Vallée de Vede in the South-east of France, two fruits which he calls *Carpolithes* and places as "Monocotyledoneæ ?, incertæ sedis;" but in a subsequent paper in the Mém. Soc. Géol. he makes them congeneric with the *Nipadites* of the London Clay. I have seen no specimens, but his figures bear no resemblance to fruits of this genus; moreover, they are not erect, but have evidently been attached at the side of the base.

Watelet has described a species from the Paris basin, which he includes, I think rightly, in *Nipadites*.

The latest and most complete revision is that of Schimper in his 'Traité Paléont. Végétale.' Six species are recognized: *N. Burtini*, including the large Belgian specimens and six of Bowerbank's species; *N. Parkinsoni* (sic), including *N. lanceolatus*, Bowerb.; *N. semiteres*, Bowerb., with *N. pyramidalis* as a synonym, following Ettingshausen; Saporta's two species and Watelet's one. Three of Bowerbank's, one of which, *N. ellipticus*, is rather distinct, are omitted. Schimper probably never saw the London-Clay fruits, or he would not have included under his diagnosis of *N. Burtini* species so obviously distinct as *N. giganteus* and *N. cordiformis*.

The genus *Palæokeura* was founded by Massalongo in 1853, in a short paper entitled "Plantæ fossiles novæ in formationibus tertiariis Regni Veneti," from specimens found near Breonio in the Province of Verona. He first referred them to *Nipadites*; but in his published account gives reasons for separating them from that genus. Some of these are insufficient, and others are based on the imperfect description of the seed given by Bowerbank. Thus, he says, it cannot be included in *Nipadites*, as it has not an umbonate apex, the base is not lacerated and hollowed, nor is the endocarp thin and fibrous, but stony; while the seed does not show in section the rows of cells radiating from the centre, nor the central embryo, described by Bowerbank, the embryo being basal. The seeds in the Sheppey fruits have, however, been entirely replaced by mineral in which I can find no indication of radiating cell-rows or a central embryo; on the contrary, the frequently hollowed base indicates the position occupied by a basal embryo; while the stony endocarp described by Massalongo is present in many of the Belgian specimens of *N. Burtini* and others. Finally, the umbonate apex is not universal, while the contracted entire base resembles that of fresh *Nipa* fruits. The description is accompanied by admirable figures of the fruit and seed, which correspond well with some from the Brussels Eocene. Schimper does not mention *Palæokeura*; but it is included by Meschinelli and Squinabol in their recently published 'Flora Tertiaria Italica' (1893).

In my revision I have carefully compared all the specimens at the British Museum, including Bowerbank's collection, a good series from the Belgian beds, and a number which Mr. Shrubsole, of Sheerness, has kindly collected for me; also a few from the London Clay preserved in the Jermyn Street Museum. Unfortunately, owing to their strongly pyritized condition, the London-Clay fossils soon "shoot their salts," as Dr. Parsons says, and crumble on exposure to air.

I was induced to look into the genus by an interesting discovery, by my friend Mr. Clement Reid, in the Bracklesham Beds, at Bracklesham and at West Wittering, Sussex, and more recently at Hengistbury Head, near Christchurch, Hants, of some fine specimens as large as the Belgian ones. Unhappily, it seems impossible to keep them for any length of time, as they consist of a carbonized shell filled with sand, which rapidly crumbles on being taken from the damp sea-beach while the carbon film cracks and peels. One brought by Mr. Reid is preserved at Jermyn Street, and another, which I brought from West Wittering, is at the British Museum. Of the latter, Mr. Worthington Smith made careful natural-size drawings immediately on its arrival, and as he has sketched both the upper and lower surfaces as well as the sides, we have a fair record of the specimen which, in the efforts to preserve it, has become somewhat broken.

One result obtained, besides a more satisfactory correlation of species and synonyms than hitherto realized, is the extension of the area of the genus in its largest species, *N. Burtini*, which, previously recognized only from Sheppey and the Brussels Eocene, is now, by Mr. Reid's discovery, pushed westward to the west of Hampshire and, in Massalongo's *Palæokeura*, eastward to North-east Italy.

The conditions under which the fossil fruits are found show that, like their modern representatives, the palms grew in the rich brackish mud of the shore or river-mouth. Associated with the Sheppey fruits are remains of crabs, freshwater turtles, and a great variety of fruits and seeds, with some stems and branches; such a collection of marine and freshwater organisms as is characteristic of the delta of a large river. The great diversity of forms and the water-worn condition of many of the specimens indicate an assemblage brought together from a large area. On the other hand, the appearance of the fruits which I saw laid bare by the receding tide on the Sussex coast argues strongly for the view that they had grown close by. So uniform was their size and condition, that they might have fallen from one tree, and having germinated almost where they fell, left only an empty shell now filled by sand. Herein, too, they differ from all other specimens I have seen. The mineral cast of the interior of the London Clay and Belgian fruits which replaces the seed was evidently formed by the filtration of dissolved mineral matter through the pericarp, while the Sussex specimens are empty shells filled with sand pushed in from outside through the aperture left in germination. The absence of teredo-borings and water-wear favours this view; but if this be the case, it is strange that there was no trace of the stem or leaves of the palm, which no one seems to have found in any of the localities. Water-worn drift-wood with coniferous and dicotyledonous structure occurred along with the West Wittering specimens.

The Belgian and Italian fruits must have floated some time, as they are often much bored, while the associated fossils have a somewhat more marine character than those of the London Clay.

In every case there is ample evidence, as Bowerbank, Ettingshausen, and Schimper have demonstrated, from both the fossil fauna and flora, of a tropical or at least subtropical climate.

NIPADITES, *Bowerbank.*

Nipadites, *Bowerbank, Fossil Fruits and Seeds of the London Clay* (1840), p. 1; *Unger, Synopsis Plantarum Fossilium* (1845), p. 180, *Genera et Species Plant. Foss.* (1850) p. 327; *Ad. Brongniart, Tableau,* (1849), p. 88; *Ettingshausen, in Sitzungsb. Mat.-Nat. Cl. Akad. Wiss. Wien,* viii. (1852) p. 491; *Schimper, Traité Paléont. Végét.* ii. (1870–72) p. 479; *Watelet, Description des Plantes Fossiles du Bassin de Paris* (1866), p. 91.

Cocos, *Burtin, Oryctographie de Bruxelles* (1784), p. 118, t. xxx. A; *Parkinson, Organic Remains* (1804), p. 457; *Ad. Brongniart, Prodrome* (1828), p. 121.

Pandanocarpum, *Brongn. Prodrome,* p. 138; *Endlicher, Genera Plantarum* (1836–40), p. 244.

Cocites, *Bronn, Lethea Geognostica* (1837), i. p. 861.

Burtinia, *Endlicher, l. c.* p. 257; *Unger, Synopsis,* p. 187, *Gen. et Sp.* p. 339; *Massalongo, Synopsis Palm. Fossil., in Lotos,* ii. (Prague, 1852), p. 205 *.

Palæokeura, *Massalongo, Plantæ Foss. Novæ* (Verona, 1853), p. 13, '*Un Nuova Genere di Pandanee Fossile*' (1853), p. 21; *Meschinelli and Squinabol, Flora Tert. Ital.* (Padua, 1893), p. 160.

Nipa, *Ettingshausen, in Proc. Roy. Soc.* xxix. (1879) p. 393.

Drupæ lanceolatæ, ovatæ, obovatæ, vel cordiformes, 4–5- rarius 3- vel 6-angulares, basi truncatæ et sæpe laceræ, epicarpio tenue lævi, mesocarpio fibroso, endocarpio duro, monospermæ, embryone basali.

NIPADITES BURTINI, *Ad. Brongn. Tableau,* p. 88; *Lyell, in Quart. Journ. Geol. Soc.* viii. (1852) p. 345, t. xix. figs. 1 & t. xx. figs. 7 & 8; *Schimper,* partim, *l. c.* p. 479. (Plate VI.)

Cocos, *Burtin, l. c.*

Cocos Burtini, *Brongn. Prodrome,* p. 121.

Cocites Burtini, *Bronn, l. c.*

* I have ignored Endlicher's *Burtinia* as, first, the evidence as to date of publication is not exact, the title-page of the 'Genera Plantarum' bearing the date 1836–40, while that of the Preface is 1841, and secondly, his very brief diagnosis will not apply to any species of *Nipadites.*

Burtinia cocoides, *Unger, Synops.* p. 187, *Gen. et Sp.* p. 339; *Massalongo, Synops.* p. 206; *Ettingshausen, in Abh. Geol. Reichsanst.* (1852) i. Abth. 3, nr. 1, p. 9.

N. giganteus, *Bowerb. Foss. Fr. Lond. Clay,* p. 22, t. vi. f. 1; *Unger, Gen. et Sp.* p. 329.

N. turgidus, *Bowerb.* partim, *l. c.* p. 21, t. v. f. 1; *Unger, l. c.*

N. Bowerbankii, *Ettingshausen*, partim, *l. c.* p. 8, *et in Sitzungsb. Akad. Wiss. Wien,* viii. (1852) p. 491.

Nipa Burtini, *Ettingsh.* partim, *in Proc. Roy. Soc.* xxix. (1879) p. 393.

Palæokeura Pellegriniana, *Massal. Plant. Foss. Nov.* p. 15, et *Nuova Gen.* (with four plates); *Mesch. et Squin. Fl. Tert. Ital.* p. 161.

Drupa magna, semipedalis, obovata, sæpius late obovata, vel fere suborbicularis, jam quadrangularis, faciebus duabus oppositis latis subcomplanatis vel convexis, duabus angustis sejunctis, jam faciebus tribus subæqualibus, vel una majore; apice obtuso interdum umbonato; basi truncata; angulis prominentibus sæpe alatis; epicarpio lævi; mesocarpio fibroso, hoc in faciebus vix unilinea, angulis autem multo crassiore; endocarpio, quum rarius apparet, duro, fere unilineo.

Size 5½–7 inches long, 4–6 inches broad, 1½–4 inches thick.

There is often a marked depression below the apex, and the prominent angles are often flattened into a thin broad wing. Many of the Belgian and the Italian specimens are much bored by Teredineæ. The cast of the interior, which takes the place of the seed, varies with the external shape of the drupe, which it almost equals in breadth and thickness, being more or less irregularly oval or oblate with three or more, usually rounded, angles. On the surface are often traces of the irregular fibrous coat like that of recent seeds.

Localities. Sheppey (London Clay). Near Selsea and West Wittering, Sussex. Hengistbury Head, Hants (Bracklesham). Woluwe and Schaerbeek, near Brussels (Middle Eocene). Breonio, Verona (Eocene).

The Sheppey fruits are strongly pyritized, those from the south coast carbonized, and those from Belgium often enclosed in concretionary nodules.

NIPADITES PARKINSONIS, *Bowerb. l. c.* p. 16, t. iv.; *Brongniart, Tableau,* p. 88; *Unger, Gen. et Sp.* p. 328; *Lyell, in Quart. Journ. Geol. Soc.* viii. (1852) p. 346, t. 19. figs. 5 & 6. (Pl. VII. figs. B, C.)

A species of Almond, *Douglas, Dissert. on Antiquity of the Earth* (London, 1785), p. 25, t. v.

Cocos sp., *Parkinson, Org. Rem.* et t. vi. figs. 5–7, t. vii. figs. 1–5.

Cocos Parkinsonis, *Brongn. Prodr.* p. 121.

Cocites Parkinsonis, *Bronn, Leth. Geogn.* p. 861.

N. turgidus, *Bowerb.* partim, *Foss. Fr. Lond. Clay,* p. 21, t. v. f. 2; *Unger, Gen. et Sp.* p. 329.

N. Bowerbankii, *Ettingsh.* partim, *in Abh. Geol. Reichsanst.* (1852) i. Abth. 3, no. 1, p. 9, *et in Sitzungsb. Ak. Wiss. Wien, l. c.*

N. Parkinsoni, *Schimper, Traité Pal. Vég.* p. 480.

Nipa Parkinsonis, *Ettingsh. in Proc. Roy. Soc.* xxix. (1879) p. 393.

Drupa quam præcedens multo minor, late obovata, subita acuminata, basi truncata; haud compressa; angulis 4–6, sæpius 4 fere æquidistantibus; pericarpio, apice crasso solido, basi multo tenuiore vix unilinea; epicarpio lævi tenue; mesocarpio cum fibris longitudinalibus sub epicarpio tenuibus et arcte confertis, tum crassioribus et sejunctis, fibrillis transversis intertextis; endocarpio duro.

A distinct species, of comparatively uniform size; the most perfect specimen measured 3½ inches in length, 2¾ inches in breadth, and 5½ inches in thickness, and the smallest 2½ inches, 2 inches, and 1½ inch respectively. The strong longitudinal fibres of the mesocarp are characteristic; they are ½–1½ line apart, the intervals being filled with closely-packed transverse fibrils.

The cast of the interior is large, from 1½–2 inches long, slightly broader, and from 1–1¼ inch thick, very broadly obovate, with a more or less acuminate apex and 4–5 more or less flattened sides with rounded angles. A fragment of a drupe not quite ripe (fig. C), in which the structure of the interior of the pericarp is preserved, shows the hard endocarp with the fibres passing from its outer surface, as obtains in *Nipa fruticans.*

Localities. Sheppey; Schaerbeek, Woluwe.

The specimen figured by Burtin, *Oryct. Brux.* fig. C, may be an internal cast of the fruit of this species.

Nipadites lanceolatus, *Bowerb. l. c.* p. 16, t. iii. fig. 7; *Unger, Gen. et Sp.* p. 328; *Lyell, in Quart. Journ. Geol. Soc.* viii. (1852) p. 346, t. 19, figs. 3 & 4. (Pl. VII. fig. A.)

N. crassus, *Bowerb. l. c.* p. 12, t. ii. figs. 4 & 5; *Unger, l. c.* p. 328.

N. Bowerbankii, *Ettingsh.* partim, *l. c.*

N. Burtini, *Schimper,* partim, *l. c.* p. 479.

N. Parkinsoni, *Schimp.* partim, *l. c.* p. 480.

Nipa lanceolata, *Ettingsh. in Proc. Roy. Soc.* xxix. p. 393.

N. Burtini, *Ettingsh.* partim, *ibid.*

Drupa lanceolata vel ovato-lanceolata, subacuta vel subobtusa, epicarpio lævi, quam in *Parkinsoni* crassiore; mesocarpio cum fibris longitudinalibus sub epicarpio arcte confertis, tum crassioribus sed minus quam in præcedente et minus sejunctis, fibrillis oblique transversis intertextis.

The specimens vary in size from 2½–3¼ inches long, 1¼–1¾ inch broad, and 5–17 lines thick, the thinnest ones being either unripe or very much compressed. As in the last species, the pericarp forms a thick, generally obtuse apical portion, while below it remains thicker than in that species; the epicarp is also thicker, measuring about ¼ line. The outer layer of mesocarp with the closely-set finer longitudinal fibres extends in the middle of the nut for a depth of about ½ a line, but is thinner below; the thicker fibres are more rarely exposed, when they are seen to be less coarse than in *N. Parkinsonis*, and only from ½–¾ line apart. The cast of the interior is, in the broader specimens broadly ovate, in the narrower oval.

Localities. Sheppey (London Clay). Schaerbeek (Middle Eocene), *fide* Lyell in Quart. Journ. Geol. Soc. viii. p. 346.

NIPADITES UMBONATUS, *Bowerb. Foss. Fr. Lond. Clay*, p. 9, t. 1; *Unger, Gen. et Sp.* p. 327.

N. clavatus, *Bowerb. l. c.* p. 15, t. iii. figs. 4–6; *Unger, l. c.*; ? *Lyell, l. c.* p. 346, t. xix. figs. 3 & 4.

N. Bowerbankii, *Ettingsh.* partim, *in Abh. Geol. Reichsanst.* viii. (1852) p. 491 *et in Sitzb. Akad. Wiss. Wien*, viii. (1852) p. 491.

N. Burtini, *Schimper*, partim, *Traité Pal. Vég.* p. 479.

Nipa Burtini, *Ettingsh.* partim, *in Proc. Roy. Soc. l. c.*

Drupa obovata, sæpe anguste, et valde compressa, vel clavata, apice obtuso vel rotundato umbonato; epicarpio lævi; mesocarpio fibroso, fibris longitudinalibus externis densis, internis velut in *N. lanceolato.*

Locality. Sheppey (London Clay).

The specimens are in most cases much compressed, and probably immature. *N. clavatus* seems to be a small form.

NIPADITES CORDIFORMIS, *Bowerb. l. c.* p. 13, t. ii. figs. 6–10; *Unger, l. c.* p. 328.

N. semiteres, *Bowerb. l. c.* p. 23, t. vi. figs. 2–4; *Unger, l. c.* p. 329; *Ettingsh. in Sitz. Akad. Wiss. Wien*, viii. (1852) p. 492; *Schimper, l. c.* p. 480.

N. pyramidalis, *Bowerb. l. c.* p. 24, t. vi. figs. 5 & 6; *Unger, l. c.* p. 329.

N. Bowerbankii, *Ettingsh.* partim, *l. c.*

N. Burtini, *Schimper*, partim, *l. c.* p. 479.
N. pruniformis, *Bowerb.* partim, *l. c.* p. 14, t. ii. fig. 12.
Nipa Burtini, *Ettingsh.* partim, *in Proc. Roy. Soc.* xxix. p. 393.
Nipa semiteres, *Ettingsh. ibid.*

Drupa minor cordiformis apice subacuto, obtusiusculo vel subacuminato, sæpe vix longior quam lata, interdum angustior; epicarpio lævi; mesocarpio cum fibris densis longitudinalibus.

The specimens vary in size from 1–2 inches long, ¾–1⅓ inches broad, and 6–10 lines thick. Many are so strongly pyritized and others so worn, that traces of the epicarp are rarely to be seen; transverse fibrils are nowhere exposed.

Bowerbank's figured specimen of *N. semiteres* (Foss. Fr. Lond. Clay, t. iv. f. 2) I have seen in the British Museum; it cannot, I think, be separated from *N. cordiformis.* Here, too, I place *N. pyramidalis*, Bowerb., the figured specimen of which is also extant; its regular pyramidal shape may be due to its position at the top of a head, or somewhere where pressure is evenly distributed on all sides.

N. pruniformis, Bowerb., probably represents unripe fruits of this or the next species, or both.

Locality. Sheppey (London Clay).

Nipadites ellipticus, *Bowerb. l. c.* p. 11, t. ii. figs. 1–3; *Unger*, *Gen. et Sp.* p. 327.

N. Bowerbankii, *Ettingsh.* partim, *in Sitzb. Akad. Wiss. Wien*, viii. (1852) p. 492.
? N. pruniformis, *Bowerb.* partim, *l. c.* p. 14, t. ii. f. 11.
Nipa elliptica, *Ettingsh. in Proc. Roy. Soc.* xxix. p. 393.

Drupa minor, elliptica, compressa, sæpe in facie una complanata, apice obtuso; mesocarpio cum fibris longitudinalibus densis, fibrillis transversis subjacentibus in solo specimine apparentibus.

The fruits vary in size from 1½–1¾ inches long, 13–15 lines broad, and 5–7 lines thick.

Locality. Sheppey (London Clay).

Nipadites Heberti, *Watelet*, *Pl. foss. du Bassin de Paris*, p. 92, t. xxix. figs. 2 & 3; *Schimper*, *Traité Pal. Vég.* p. 480.

Drupa majuscula, late elliptica, quadrangularis, compressa; epicarpio lævi; mesocarpio fibroso.

Judging from the figure and description, near *N. elliptica*, Bowerb., but more globose.

Locality. Issy, near Paris (Calcaire Grossier).

Species non satis nota.

NIPADITES ACUTUS, *Bowerb. l. c.* p. 14, t. iii. fig. 1; *Unger, l. c.* p 328.

N. Bowerbankii, *Ettingsh.* partim, *l. c.*
Nipa Burtini, *Ettingsh.* partim, *l. c.*

Drupa basi major, superne deminuta, apice acuto; mesocarpio cum fibris densis longitudinalibus, crassioribus interspersis.

The specimen figured by Bowerbank is nearly 2½ inches long, and 1⅓ inch broad near the base; it is much worn, and shows stronger longitudinal fibres with the intervening spaces filled with finer closely set ones with the same direction, but no trace of transverse fibrils. I can find no second specimen; and the one described is, in my opinion, too misshapen to form the type of a distinct species.

Locality. Sheppey (London Clay).

Species excludendæ.

NIPADITES PROVINCIALIS, *Saporta, in Mém. Soc. Géol. France,* 2. viii. (1868) p. 303, fig. 2; *Schimper, Traité Pal. Vég.* p. 480.

Carpolithes provincialis, *Saporta, in Ann. Sc. Nat.* (*Bot.*) sér. 4. xvii. (1862) p. 200, t. i. fig. 6.

NIPADITES CURTUS, *Saporta, in Mém. Soc. Géol. l. c.*; *Schimper, l. c.*

Carpolithes curtus, *Saporta, l. c.* p. 201, t. i. fig. 7.

EXPLANATION OF THE PLATES.

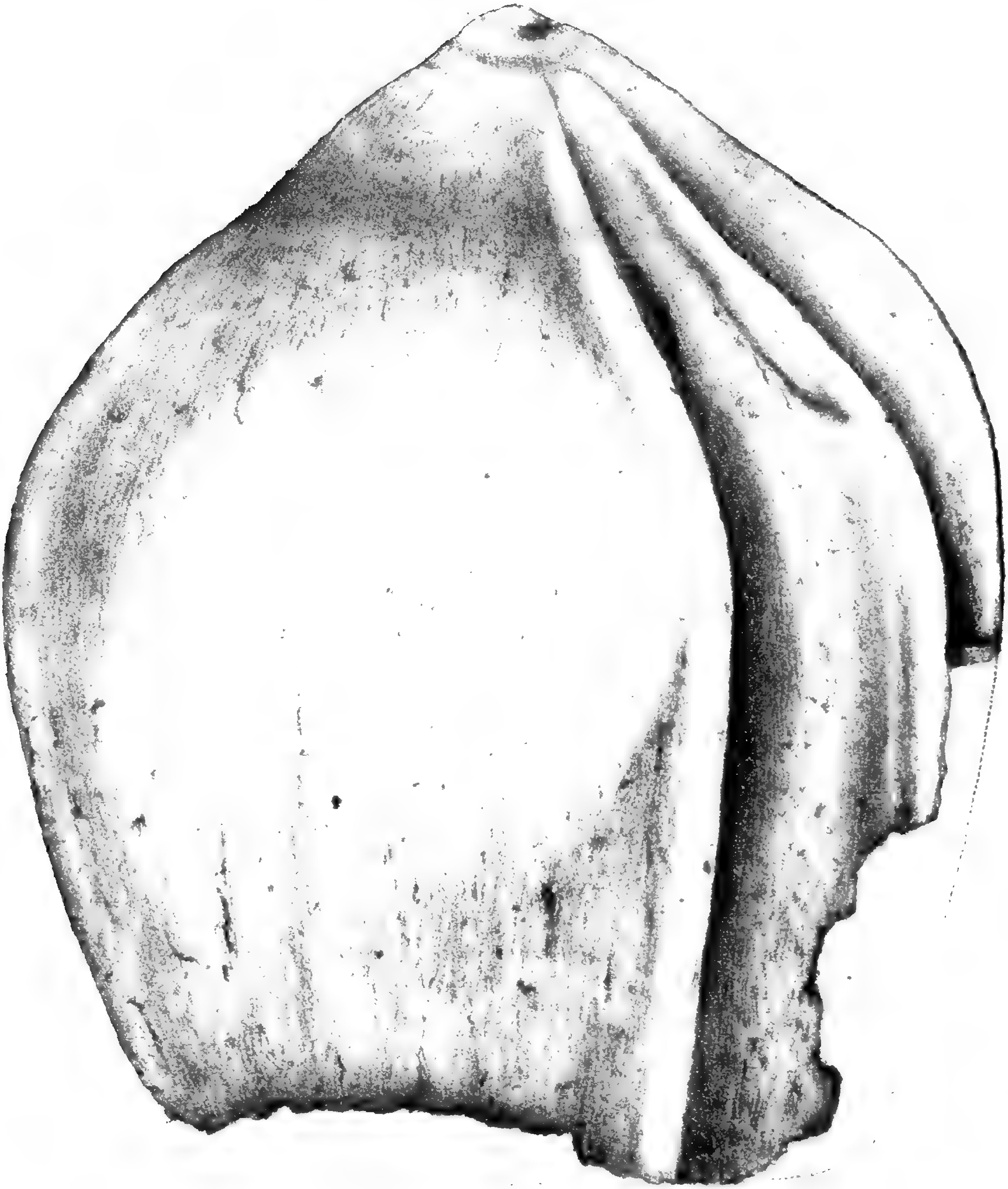
PLATE VI.

Nipadites Burtini, Brongn. From West Wittering, Sussex. Natural size.

PLATE VII.

A. *Nipadites lanceolatus,* Bowerb. The lower part broken away disclosing the seed-cavity.
B. *Nipadites Parkinsonis,* Bowerb.
C. The same in longitudinal section, showing at *e* fibres passing outwards from the hard endocarp.

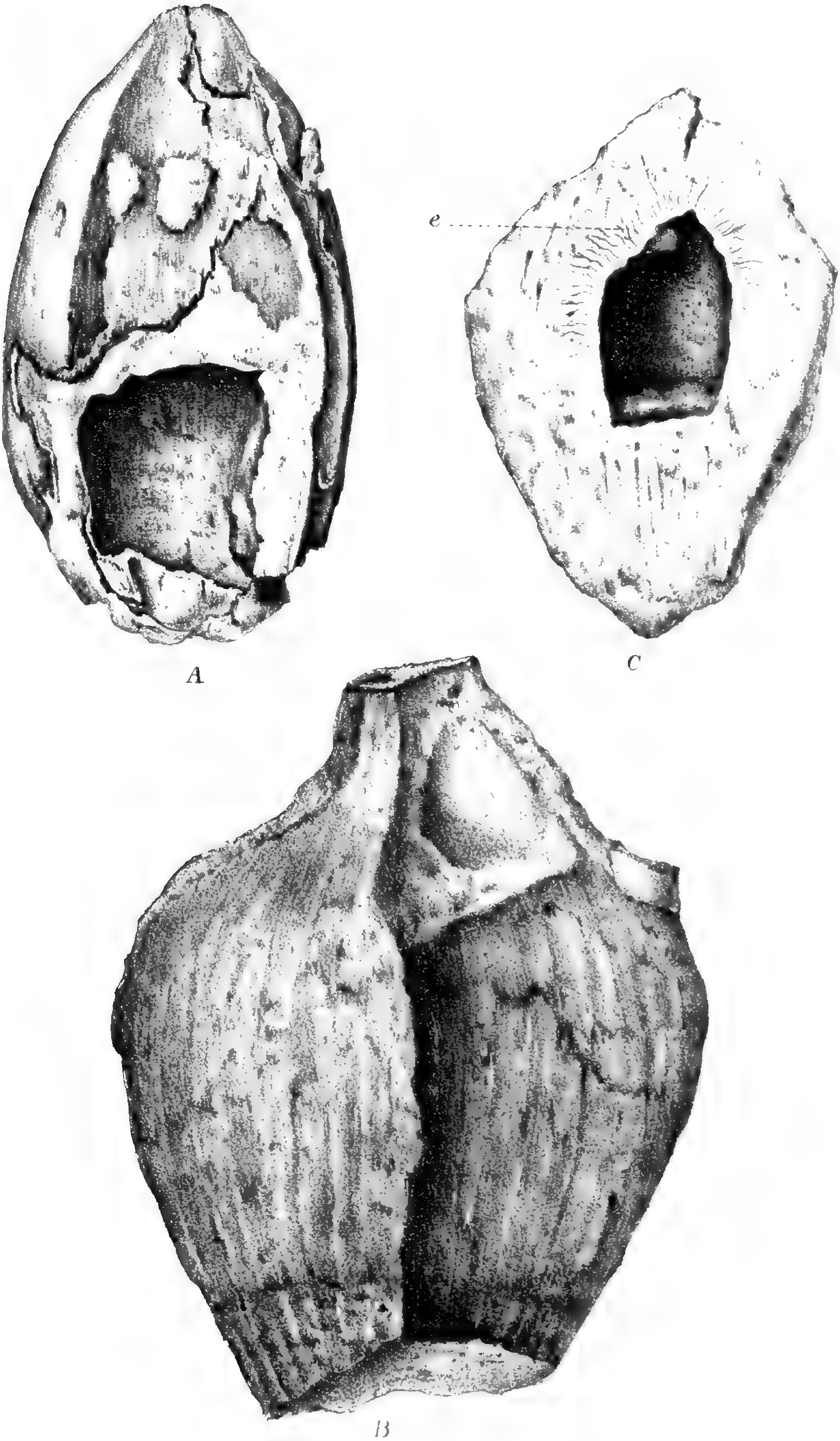
All natural size, from Sheppey specimens in Bowerbank's own collection the Geological Department of the British Museum.



A.G. Smith del.
R. Morgan lith.

West, Newman imp.

NIPADITES BURTINI, *A. Brongn.*
from Sussex.



R. Morgan del. et lith.

West, Newman imp.

A, NIPADITES LANCEOLATUS Bowerb. B & C, N. PARKINSONIS Bowerb.

On the Anatomy of a Plant from Senegambia. By ANNIE LORRAIN SMITH. (Communicated by G. F. SCOTT ELLIOT, M.A., F.L.S.)

[Read 15th June, 1893.]

(PLATE VIII.)

THE unnamed plant described below was brought home from Tropical Africa by Mr. Scott Elliot, who found it on dry sandy laterite, between Sulimania and the Niger, about a quarter of a mile before the Farana ford. He very kindly placed it, along with his notes, at my disposal for investigation.

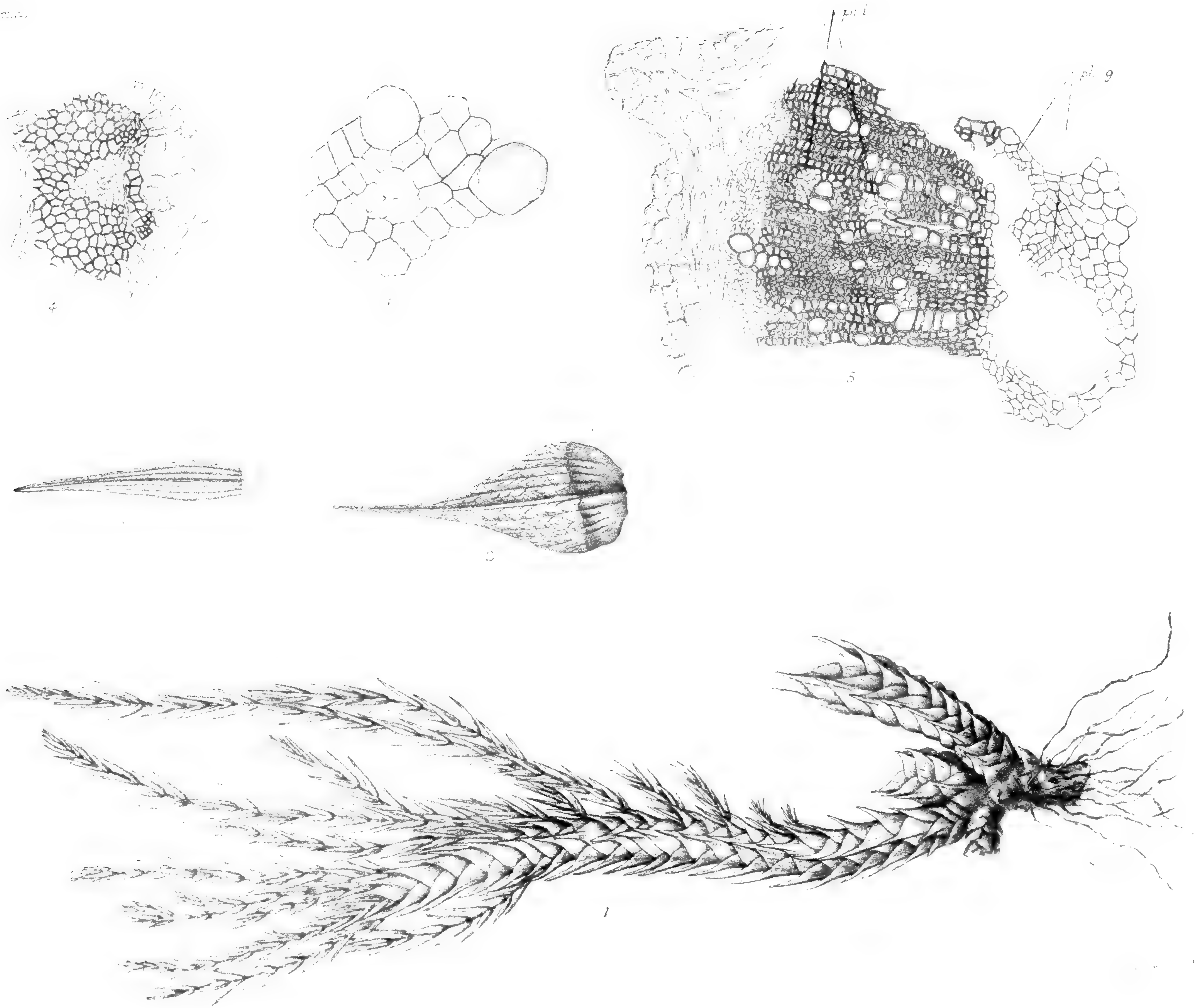
Our object has been to see if anatomical characters would throw any light upon the affinity of the plant, which, unfortunately, had neither flower nor fruit to guide us in its determination. The plant is one of striking facies and likely to imprint its appearance on the memory, but no systematist at the British Museum or at Kew has recognized it. The guesses as to its affinity from macroscopic characters alone varied from *Lycopodiaceæ* and *Coniferæ* on to *Acanthaceæ*, *Melastomaceæ*, and *Thymelæaceæ*. I do not propose to give a very detailed account of the anatomy, since dried specimens do not afford adequate material for such a task. I have, however, made out enough to indicate the interesting character of the subject of examination.

On Pl. VIII. fig. 1, I have represented part of the plant reduced by one third. The root-stock, which is broken off just below the ground, is a stout structure with lateral rootlets, and is evidently persistent from year to year. The primary branches are radical and grow from 9 inches to a foot in height; they have no annual rings, and can be of only one year's growth. The leaves are decussate with a marked stipular line; the broad bases embrace the stem, and they closely overlap the pair of leaves immediately above (fig. 1). The secondary slender branches have grown about half the height of the primary branches, they are inserted a little to the side of the axil of alternate leaves with a divergence of $\frac{1}{2}$, but only those near the tip of the parent branch attain to full development. These secondary branches are round or only slightly flattened; the primary branches are flattened to an almost rectangular shape. The older leaves are broad at the base, cordate-acuminate, with parallel veins and a strong midrib ending in a hard point. The leaves of the younger branches are narrower and less developed, and show three distinct veins, especially after maceration. The veins are interlaced by strands of sclerenchyma (fig. 2), and curve in at the base of the leaf, entering the stem together as one bundle.

The whole plant appears to be adapted to desert growth and even to the occurrence of desert fires. The natives are in the habit of burning down the grass every year, and this specimen bore distinct traces of scorching; the soft tissue of the broad leaves is burned, except the part protected by the leaf below (fig. 2), the sclerenchyma is laid bare, but the leaf as a whole remains; the secondary branches and leaves, which are unharmed, are of more recent and evidently very rapid growth. The plant was gathered after the first two or three tornados of the rainy season, but before the rainy season proper, *i. e.* just when everything is starting growth. The larger internodes and smaller leaves of the crowded branches indicate very clearly a change in the conditions of life.

The stipular sheath of the stem is strongly sclerotic; the same arrangement of cells extends up the back of the leaf over the midrib (Pl. VIII. fig. 4), affording additional protection against external influences. The cortex is crushed, and as a rule the normal phloem is very much reduced. The part of the stem I have chosen for figure 5 showed the phloem more distinctly than at any other point. The outer xylem consists of wood fibres and vessels with bordered pits; the vessels of the inner xylem are spiral. Just inside these, round the periphery of the pith, are groups of phloem (fig. 5) belonging to the leaf-trace bundles. This tissue passes out to form the bi-collateral bundle of the leaf, and remains active in the inner protected portion of the leaf, the normal phloem being much crushed (fig. 4). The smaller bundles, as is often the case, do not seem to be bi-collateral. Scattered irregularly through the xylem is a series of phloem islands developed centrifugally from the cambium (figs. 5 & 6). This is plainly seen from the radial position of the cells of the phloem islands, which consist of sieve-tubes and companion cells with parenchyma. There are also some islands in process of formation which show no trace of internal cambium. The medullary phloem groups show no cambium; the central pith is composed of large pitted cells densely filled with needle crystals of calcium oxalate.

I have not drawn any longitudinal sections owing to the state of the material; callus had in each case formed over the sieve-


4
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Berjeau & Highley lith.

NEW PLANT FROM SENEGAMBIA

plates obliterating the perforations, and the medullary phloem was much shrivelled. Dr. Scott, to whom I am much indebted for confirming my anatomical observations, thinks it would be almost impossible to detect perforations in material so long gathered and so dry. I failed to do so with a magnification of 1300 diameters. The lateral roots show interxylary phloem islands; I have been unable to see very young stages, but I do not think they lie within the primary wood as in *Chironia* and *Strychnos* *.

According to our present knowledge, this peculiar anatomical structure considerably narrows down the systematic limits within which the plant must come. To decide as nearly as possible what might be its affinity, I have examined plants belonging to the orders *Loganiaceæ*, *Acanthaceæ*, *Peneaceæ*, *Gentianaceæ*, and *Melastomaceæ*, but without such definite success as would warrant my placing it in any of them.

In some respects this essay may be instructive in showing the limits of plant anatomy in affording characters of value to the systematist.

My anatomical work has been done in the Laboratory of the Botanical Department of the British Museum, and I have to thank the officials both for advice and material.

EXPLANATION OF PLATE VIII.

Fig. 1. Part of plant, reduced one third.
2. Broad leaf, slightly enlarged.
3. Narrow leaf, slightly enlarged.
4. Transverse section of leaf mid-rib, × 150.
5. Transverse section of part of primary branch: *ph.i.*, phloem islands; *ph.g.*, phloem groups: × 150.
6. Transverse section of phloem island, × 450.

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* Scott and Brebner on Internal Phloem in the Root and Stem of Dicotyledons. Annals of Botany, vol. v. p. 281.

THE FLORA OF THE TONGA OR FRIENDLY ISLANDS, with Descriptions of and Notes on some New or Remarkable Plants, partly from the Solomon Islands. By W. BOTTING HEMSLEY, A.L.S., F.R.S. (Contributed by permission of the Director of the Royal Gardens, Kew.)

[Read 1st June, 1893.]

(PLATES IX.–XI.)

1. *Introductory Note on the Tonga Flora.*

ALTHOUGH I have drawn up as complete a list as I could of the vascular plants hitherto collected in the Tonga Islands, the few preliminary observations I have to make on the flora of that group relate chiefly to a collection of dried plants, mostly from the island of Eua, made by Mr. J. J. Lister during the years 1889 and 1890. As Mr. Lister is present and has promised to give you some particulars of the position and composition of the islands, and of the local conditions under which plant-life exists *, it will be sufficient for me to point out that the Tonga Islands lie a little south-east of Fiji, that Eua lies to the south-east of the comparatively very low (about sixty feet in its highest part) though much larger island of Tongatabou, and that it has a central ridge of high ground which attains a height of upwards of 1000 feet above the level of the sea. Tongatabou was touched, I believe, by Cook on all three voyages, for there are Tongan plants in the British Museum collected by Banks and Solander, by Forster, and by Nelson. Various other expeditions have touched there, including Wilkes's United States and the 'Challenger' expeditions; and as the late Professor Moseley's collection made there on the voyage of the 'Challenger' has not been published, I propose including it in the Enumeration which follows these observations.

The vegetation of Eua differs from that of Tongatabou in having some peculiar species, at least so far as our present data go; and it also includes a considerable number of Polynesian forms not found in the low coral islands. The violaceous *Melicytus ramiflorus* is one of the most interesting plants found in Eua by Mr. Lister. It is a common New Zealand shrub or small tree, which has also been collected in the Kermadec Islands and in Norfolk Island; and Mr. Lister's discovery gives the genus a considerable north-eastern extension. Besides the New-Zealand species there are two or three undescribed ones from New Caledonia, but I am not aware that the genus exists in Fiji. Among the Mangroves collected by Mr. Lister is a small specimen which Dr. Stapf has identified with the American *Rhizophora Mangle*, a species common on the shores of tropical America and also found on the West-African coast. I have compared it myself, and I agree with Dr. Stapf that it is much more like the American than either of the Old World, or eastern species; but it may have been accidentally introduced with ballast. With the permission of Mr. Thiselton Dyer, the Director of Kew, I am able to show you this and a selection of other interesting objects from Polynesia.

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* Mr. Lister has kindly communicated the substance of his remarks, which will follow my observations on the flora.

Several of the plants collected in Eua have not been exactly matched, but my Kew colleagues and I have not ventured to describe many of them because we are unwilling to add unnecessarily to synonymy, and much research would be involved in thoroughly working them out. *Ardisia Listeri* and *Cyrtandra Listeri* are inconspicuous species of their genera, but apparently quite distinct from anything described. *Graptophyllum Siphonostena* had previously been found in Fiji and Samoa, and Dr. Stapf has now fully described it. The plant I have doubtingly referred to the Monimiaceous genus *Hedycarya* is in too young a condition for satisfactory determination.

Mr. Lister's Tongan collection numbers nearly 200 species of vascular plants, of which about 100 were not previously represented in the Kew Herbarium from those islands; nor are they recorded in Seemann's 'Flora Vitiensis' as being in the British Museum.

Moseley collected 76 species of vascular plants in Tongatabou; and the following enumeration of all the plants collected by Moseley, Lister, and recorded by Seemann in his 'Flora Vitiensis,' contains 337 species belonging to 234 genera and 82 natural orders. I had not time to work out their distribution in detail previous to reading this paper; but Mr. J. F. Jeffrey has rewritten the Enumeration and collected the details of the distribution of each species, so far as it could be done at Kew, from manuscript lists and published records, and constructed the table upon which my remarks, at the end of the Enumeration, on the composition of the flora are based. A close scrutiny of the Kew and British Museum herbaria would probably yield a few additional species.

2. *Notes on the Position, Geology, and Aspects of the Vegetation of the Tonga Islands.* By J. J. Lister, Esq., M.A.

The Tonga or Friendly group consists of a number of small islands scattered along an axis whose direction is N.N.E. and S.S.W. The length of the group is about 200 miles. Some 400 miles to the W.N.W. are the large islands of Fiji, and the Samoa islands are about 300 miles away in the direction of the axis northward. Tongatabou*, the largest island of the group, is situated at the southern end, and is about 1000 miles from Auckland in New Zealand. The 20th parallel of south latitude passes through the middle of the group.

The group is composed in part of a line of volcanoes which traverses it lengthwise. Some of these are still active, while others are only the broken-down remnants of volcanoes which have been long extinct. In 1885 a submarine eruption occurred, and a mound of ashes † was built up in the interval between two of the existing islands; but this has since been largely worn away by the sea.

The other islands of the group are for the greater part formed of reef-limestone. In some of them an underlying basis is exposed, formed of volcanic tuffs laid out beneath the sea, and in a few cases the islands consist entirely of the latter formation.

Movements both of elevation and subsidence have occurred, but the more recent tendency has been, in the main at least, one of elevation. *Vavau*, a limestone island in the northern part, is about 500 feet high; and *Eua*, in the south, is over 1000 feet. Some of the volcanoes attain greater heights. The other islands are for the most part little elevated and flat. Generally it may be said that all the high ground of the group is either the summits of volcanoes, active or extinct, or composed of reef-limestones, which were, of course, formed beneath the sea.

Soundings show that the islands are situated at the northern end of an extensive plateau which reaches far to the southward in the direction of New Zealand. In the interval between its southern limit and those islands is another shoal area, on which the small volcanic Kermadec Islands are situated. It has been pointed out that the volcanoes of the Kermadec and Tonga Islands continue the direction of those of the Taupo zone of volcanoes of the North Island of New Zealand. To the east of the Tonga plateau the sea-bottom descends to 4530 and 4429 fathoms, the greatest measured depths in the southern hemisphere. Between Tonga and Fiji there is a depth of 1500 fathoms.

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* Designated Amsterdam Island in some of the older charts.—W. B. H.

† Falcon Island, it has been named.—W. B. H.

At the close of the last century the Tonga Islands appear to have been thickly populated and extensively cultivated. At the present time the population has greatly decreased, and much of the cultivated land has passed into a wild state.

The higher part of the island of *Eua* presents a vegetation of a different character from that met with in the adjoining islands.

This island, which is rather more than twelve miles long, is composed of a basis of volcanic tuffs overlain by reef-formation. On the high ridge of the island the limestone appears in isolated masses and pinnacles, which stand out above the red volcanic soil, while in the lower part it forms wide terraces at different levels, the upper ones ending in lines of inland cliffs. The eastern side, presented to the trade wind, rises abruptly from the shore in ranges of limestone cliffs alternating with steep slopes, covered with a dense wind-swept forest-growth. On the western side the surface is scored by watercourses which traverse the volcanic basis. The streams, on meeting the limestone terraces, dip underground and pursue a subterranean course to the sea. This aspect is in marked contrast with the eastern. Instead of the dense wind-swept growth, there are wide open spaces alternating with belts of luxuriant bush which cover in the water-channels. The open spaces are often dotted over with Screw-Pines (*Pandanus odoratissimus*) with their curious prop-like air-roots, and are generally covered with a coarse herbage. In the volcanic part the soil is often bare, and shows bright red, yellow, or brown from the decomposing rock. When it is covered the tracts of volcanic formation can be recognized by the plants which grow on them: *Melastoma denticulatum* and some of the Ferns are, I believe, never found elsewhere. The great crowns of the Tree-Ferns are conspicuous features when looking down on a tract of bush from the cliffs. Along the eastern shore the *Piu* or *Biu* Palms (*Pritchardia pacifica*), with their great fan leaves, are very handsome objects. The trees are not generally very high, running to about 60 to 80 feet. After penetrating the outer edge of a belt of bush, festooned with creepers, *Entada scandens* and various species of *Ipomœa*, with sulphur-coloured, blue or purple flowers, there was generally no difficulty in making one's way about.

My collections at Eua were made during a visit of a fortnight in December 1889, and in two days which I spent there in June of the same year. In December I think I obtained most of the plants which were in flower at the time in the higher part of the island, but I have no doubt that there are many plants on the island not represented in the collection.

In conclusion I may perhaps be permitted to point out that while the contour of the sea-bottom, with the great southerly extension of the Tonga plateau, suggests that a closer connection may at one time have existed between New Zealand and land to the northward, the geological structure of the present Tonga islands would not lead us to expect that an ancient fauna and flora survives on them; for, as was shown above, all the high ground of the group either consists of the outpourings of volcanoes, or has been submerged within the period during which the existing reef-limestones have been formed.

Mr. E. A. Smith informs me that the land mollusks are quite of a Polynesian character, and show no special affinities with those of New Zealand.

With regard to the birds, to which I have devoted some attention, the same statement holds good. Compared with those of Fiji and Samoa, the birds of Tonga are few in number and very little specialized. There are no peculiar genera, and probably only four peculiar species, each of which is represented by allied species, both in Fiji and Samoa. With the very peculiar bird-fauna of New Zealand there are certainly no special affinities[*].

J. J. Lister.

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[*] A fuller account of the Geology of the Tonga Islands will be found in the Quarterly Journal of the Geological Society, November 1891, vol. xlvii. p. 590.

3. *Observations on some Remarkable Plants from the Solomon Islands.*

The Solomon group consists of a chain of islands, some 600 miles in length, extending in a south-easterly direction, from New Britain and New Ireland (now the New Pomerania and New Mecklenburg of the Germans), nearly to the New Hebrides. The larger islands are from 50 to 100 miles in length, and 15 to 30 miles in breadth, with elevations of 8000 feet in Guadalcanar, in the south, to 10,000 feet in Bougainville, in the north. So far as I know, none of the earlier voyagers landed in these islands; but they were visited by D'Urville in 1838, and by Denham (H.M.S. 'Herald') in 1853; and William Milne, who was attached to the 'Herald' in the capacity of botanical collector for Kew, collected some 200 species of plants in the coast region, nearly all of which are plants of wide range. Within the last decade, however, both English and Germans have reached the mountains of the interior of some of the islands, and discovered a varied and curious indigenous flora. Dr. K. Schumann has published some of the novelties collected by Dr. Naumann and other Germans in the ninth volume of Engler's 'Jahrbücher'; and Dr. H. B. Guppy, in his book entitled 'The Solomon Islands and their Natives,' gives a rough list of the plants he collected, from approximate determinations made at Kew. This collection contained a considerable number of novelties, some of which have since been described by Dr. Beccari, Professor D. Oliver, and myself; but many of the specimens were insufficient for description, though evidently undescribed. To some considerable extent this collection has been supplemented by the Rev. R. B. Comins, who brought home a small parcel of dried plants in 1890, and who has since sent to Kew two other small parcels. It is not my intention at present to attempt to give an enumeration of all the plants known from the Solomon Islands, because it would be, at best, a very small fragment of a manifestly rich endemic flora, therefore I will confine myself to directing attention to a few of the more remarkable plants contained in the collections to which I have referred.

As Dr. Guppy was first in the field, I will begin with some of his novelties. Myrmecophilous plants appear to abound, especially the rubiaceous genera *Hydnophytum* and *Myrmecodia.*

They are epiphytes growing chiefly on the mangrove trees and bushes on the coast. The galleried tuberous stems are sometimes as much as eighteen inches long. I have here an example of each genus. A new genus of Pandanaceæ (which I have named *Sararanga sinuosa*, Sararang being the native name of this tree, see p. 216, Pl. XI.), a tree fifty feet high, with long, narrow, almost unarmed leaves, and a panicled spadix of white female flowers, was discovered in Fauro island at elevations of 1600 to 1900 feet, and is, indeed, the most remarkable plant of the collection. Dr. O. Beccari collected the same, or a closely allied species, in the island of Jobie, North-western New Guinea, and about twenty degrees west of Fauro. Although the material is incomplete I propose publishing such a description of it as I can. *Cominsia Guppyi*, Hemsl.*, is a new genus of Scitamineæ, allied to *Phrynium*, and characterized by an elongated inflorescence with the flowers clustered in boat-shaped bracts, and opening one at a time. The elongated tube of the corolla, the dehiscent fruit, and the rugose corky seed with an empty cavity parallel to the curved embryo, are also characteristic. This plant was collected in Fauro Island by Dr. Guppy, and in San Christoval, in the extreme south of the group, by Mr. Comins.

Proceeding to some of Mr. Comins's plants, I will first direct attention to the Sapotaceous genus *Chelonespermum*, published last year (1892) in the 'Annals of Botany,' with illustrations from admirable drawings by Mrs. Thiselton Dyer and Miss M. Smith. The genus was really founded upon the seeds, which are, indeed, among the most curious in the vegetable kingdom. One is contained in each fruit, which is pear-shaped, and has a more or less fleshy pericarp, though the ovary is two-celled, with one ovule in each cell. The seed is a dorsi-ventral body, and I may explain that it is erect in the fruit with reference to these two very different surfaces. On the smooth surface or back, the pericarp is quite thin, whereas on the uneven or hilum surface it is pulpy, and of sufficient thickness to form a symmetrical fruit. The embryo fills the whole cavity of the testa, or is enveloped in a very thin film of endosperm, at least in the mature state. It has two very large, fleshy, plano-convex cotyledons applied face to face, and a short thick radicle, which probably emerges in germination through an opening in the testa, the beginning of which may be seen in some of the seeds near the base. I extracted the embryos for examination, and afterwards stuck the testa together again to make museum specimens. I have described four species of this genus: two from the Solomon Islands, one from Fiji, collected by Mr. J. Horne, the late Director of the Mauritius Botanic Gardens, and one presented to Kew by the Rev. G. Henslow, the native country of which is unknown. According to Mr. Comins's notes these seeds are known in the Solomon Islands by a name signifying turtle-seed; hence my name *Chelonespermum*.

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* 'Annals of Botany,' v. p. 501, pl. 27.

The next thing I have to notice is *Lepinia taitensis*, which has one of the most singularly constructed fruits in existence. It is a member of the Apocynaceæ, and in the flowering-stage the ovary is undivided, but soon the usually four carpels of which it is composed separate from each other except at the tips, and develop long slender stalks carrying up the seed-bearing portions in the form of a cross. This tree would appear to be exceedingly rare. Decaisne described and figured it as long ago as 1849 from Tahitan specimens, and, so far as I am aware, it has not been found in any locality between Tahiti and San Christoval, in the Solomon Islands, where Mr. Comins collected the present specimen, localities separated by about 3300 miles of water and small islands. I think it must be extremely rare in Tahiti, because we have no specimen in the many collections from that island at Kew, nor does it exist in any of the earlier collections in the British Museum. I will not attempt to explain the object of this curious development.

I will conclude these notes with a few remarks on some other new plants from Mr. Comins's last collection, described at p. 211. *Dysoxylum megalanthum*, a Meliaceous tree, is remarkable for the large size of its flowers. *Crossostyles Cominsii* (p. 212) is a member of the Legnotideæ, and the present species is characterized by having entire petals and no staminodes. *Eugenia salomonensis* is a very showy species of its genus, and *Ruellia Guppyi* must be a very ornamental plant.

Finally I may mention *Antiaris turbinifera* (p. 215), the Humming-top tree of the natives, who make humming-tops of the crustaceous endocarp of the fruit.

4. ENUMERATION *of the Vascular Plants of the Tonga Islands, together with their Distribution, Local and General.*

The following Enumeration is, perhaps, not quite complete, because I have not searched the herbaria systematically through; that being a task beyond the time at my disposal. Nevertheless it is doubtless very nearly exhaustive so far as Kew and the British Museum Collections are concerned, because I have taken up every species recorded by Seemann ('Flora Vitiensis') as existing in the British Museum from the group. I have included all the lists of Tonga plants in the Kew Herbarium—or rather Mr. Jeffrey, to a great extent, collected this information for me; and I have specially examined the Kew Herbarium in many instances for plants of whose existence in the Tonga group I had no evidence, although they are known to inhabit either the Fijis or Navigator Islands, or both. Among such as I have not found are *Lepidium piscidium*, Forst., *Kleinhovia hospita*, Linn., *Afzelia bijuga*, A. Gray, *Parinarium insularum*, A. Gray, *P. laurinum*, A. Gray, and *Flagellaria indica*, Linn. But Mr. Lister particularly mentions, p. 162, that he is of opinion that he did not exhaust the botany of the island of Eua. Briefly, the sources are the British Museum and Kew Herbaria; published so far as the former is concerned, and mostly unpublished so far as the latter is concerned. The principal books used are A. Gray's 'Botany '(1854) of the United States Exploring Expedition, 1838–1842; Seemann's 'Flora Vitiensis,' 1865–73; Hillebrand's 'Flora of the Hawaiian Islands,' 1888; and Drake del Castillo's 'Flore de la Polynésie Française,' 1893. I did not think it desirable to consult the earlier works, such as Endlicher's 'Bemerkungen über die Flora der Südseeinseln,' 1836, and Forster's 'Florulæ Insularum Australium Prodromus,' 1786, because without a great expenditure of time it might have led to confusion in the nomenclature.

The plan of the Enumeration is to give as near as possible the most generally used name of each plant, with a few of the more important synonyms, such as are employed in the works named, followed by the names of the persons who have collected the plant in the Tonga Islands, and its general distribution *. The collectors who contributed the material here consolidated are about twenty in number. First come the early collections deposited mainly in the British Museum, though some of them are also represented in other herbaria. These are by Sir Joseph Banks and Dr. D. C. Solander, who accompanied Captain Cook on his first voyage in 1768–1771; Dr. J. Reinhold Forster and his son George, who were naturalists to Cook's second voyage, 1772–1775; and Mr. David Nelson, who was on the third voyage in 1776–1780. Some of the specimens in the British Museum are simply marked "Cook," without any indication of the voyage. Another important collection in the British Museum, of which there is also a set at Kew, was made by George Barclay, on the voyage of H.M.S. 'Sulphur,' from 1835–1841. He was primarily a collector of seeds and living plants for Kew, and his letters to W. T. Aiton, the director, and J. Smith, the curator, are preserved there. The Tonga plants in the Kew Herbarium include a portion of the Forsters' collection; a few collected by James Macrae, who travelled for the Horticultural Society of London, 1824–1826; a small number labelled "Beechey," who was Captain of H.M.S. 'Blossom,' 1825–1828; a considerable collection made by Alexander Mathews, a Chiswick gardener, in 1841; a few by Sir Everard Home in 1851; a collection made by the algologist W. H. Harvey during his sojourn in the southern hemisphere, 1854 to 1856; a collection made by Dr. Græffe, a Swiss gentleman, about 1862; Professor H. N. Moseley's collection made on the voyage of H.M.S. 'Challenger,' 1873–1876; a collection made by Mr. T. B. Cartwright during a cruise in 1888; and, finally, Mr. J. J. Lister's collection, chiefly from the island of Eua, made in 1889 and 1890. In addition to the foregoing, the French collectors or commanders of expeditions, Lesson, Hombron and D'Urville, are sometimes cited; a German named Jensen, who collected some Cyperaceæ determined by Mr. C. B. Clarke; and the United States Exploring Expedition; a set of plants of the last being in the Kew Herbarium. It has not been considered necessary to cite the names of all collectors in each case. The names of a few persons who have contributed one or two plants only are not included in the foregoing account.

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* In the distribution, "Samoa" is employed to designate the particular island and "Navigator" the group. This group is reckoned east of the Tonga or Friendly Islands.

In answer to my inquiries respecting cultivated plants, Mr. Lister informs me that the cocoa-nut, tobacco, sugar, maize, taro (*Colocasia antiquorum*), pine-apple, orange, lime, breadfruit, yam, sweet potato, kava (*Piper methysticum*), paper mulberry (*Brous-*

sonetia papyrifera), and a number of varieties of banana are cultivated; but the only one of these plants that struck him as being also wild was the cocoa-nut. Cotton was formerly cultivated and has become colonized, but he is unable to say from actual observation whether the cultivation is still continued. With regard to the bamboo, its presence in the island has not been impressed on his memory; yet there is one, *Schizostachyum glaucifolium*, Munro, which might be expected to occur, as it inhabits the Fiji, Navigator, Society, and Marquesas Islands.

ANONACEÆ.

Cananga odorata, Hook. f. et Thoms.—*Græffe*; *Moseley*.

Ava, Tenasserim, Java, and Philippines. Cultivated widely in the tropics.

Anona squamosa, Linn.—*U.S. Expl. Exped.*

Introduced from America.

MENISPERMACEÆ.

Stephania hernandiæfolia, Walp. (including *S. Forsteri*, A. Gray).—*U.S. Expl. Exped.*; *Harvey*.

Samoa, Tahiti, and Marquesas Islands, Australia northward through tropical Asia to China and Japan; also in tropical Africa.

CRUCIFERÆ.

Cardamine sarmentosa, Forst.—*Barclay*; *Cartwright*.

New Caledonia, Fiji, Union, Samoa, Society, and Marquesas Islands; also recorded from Peru, about Lima, where it was doubtless introduced.

Senebiera didyma, Pers.—*Cartwright*.

A widely-spread weed, the native country of which is uncertain.

[*Lepidium piscidium*, Forst., a characteristic sea-side plant from New Caledonia to the Society and Sandwich Islands, including many of the small coral islands, is not represented in the Kew Herbarium from the Tonga Islands, nor have I found any record of its occurrence.]

VIOLARIEÆ.

Melicytus ramiflorus, Forst.—*Lister*.

Norfolk Island, the Kermadec group, and New Zealand.

BIXINEÆ.

Xylosma orbiculatum, Forst.—*U.S. Expl. Exped.*; *Lister.*
Fiji eastward to the Marquesas Islands.

PITTOSPOREÆ.

Pittosporum arborescens, Rich.—*U.S. Expl. Exped.*; *Græffe*; *Lister.*
Fiji Islands.

Pittosporum Brackenridgei, A. Gray.—*Cartwright*; *Lister.*
Fiji Islands.

Pittosporum rhytidocarpum, A. Gray.—*Lister.*
Fiji Islands.

PORTULACEÆ.

Portulaca oleracea, Linn.—*U.S. Expl. Exped.*
Common, especially in maritime districts, in tropical and subtropical regions generally.

Portulaca quadrifida, Linn.—*Barclay*; *U.S. Expl. Exped.*
Warm regions of the Old World.

GUTTIFERÆ.

Garcinia sessilis, Seem.—*Nelson*; *Lister.*
New Caledonia and Fiji Islands.

Calophyllum spectabile, Willd.—*U.S. Expl. Exped.*
Fiji and Society Islands, Java, Malayan peninsula, and Ceylon.

MALVACEÆ.

Sida microphylla, Cav.—*Forster*; *Moseley.*
New Caledonia, Fiji and Samoa Islands, Pescadores Islands in the Marshall Group, India, and Bourbon.

Sida rhombifolia, Linn.—*Cartwright*; *Lister.*
Fiji to Marquesas Islands; and tropical and subtropical regions generally.

Sida spinosa, Linn.—*U.S. Expl. Exped.*
Sandwich Islands ("a late arrival from tropical America"). Tropics and subtropical regions generally.

Urena lobata, Linn.—*U.S. Expl. Exped.*; *Harvey*; *Cartwright.*
Fiji to Marquesas Islands. Tropics generally.

Urena morifolia, DC.—Recorded from the Tonga Islands on the authority of DeCandolle (Prodr. i. p. 442).

Fiji Islands.

This has been doubtfully referred by Dr. Masters (in Hook. f. Fl. Brit. Ind. i. p. 330) to *U. sinuata.*

Hibiscus Abelmoschus, Linn.—*Barclay*; *Lister*.

Cultivated and wild in most tropical countries, but uncertain where it is really indigenous.

Hibiscus Rosa-sinensis, Linn.—*Home.*

Fiji eastward to the Marquesas Islands (cultivated and subspontaneous). China, India, Java, and Timor.

Hibiscus tiliaceus, Linn.—*Harvey*; *Cartwright*; *Lister*, and others.

Fiji to Marquesas and Sandwich Islands; and generally dispersed in the tropics and extending to some subtropical countries.

Thespesia populnea, Corr.—*Lister.*

Fiji to the Marquesas and Sandwich Islands, and tropics of the Old World, chiefly on sea-shores, including Western Africa.

STERCULIACEÆ.

Heritiera littoralis, DC.—*Nelson*; *U.S. Expl. Exped.*

New Caledonia and Fiji. Littoral in tropical Asia, Australia, and E. Africa.

Melochia odorata, Forst.—*Forster*; *Barclay*; *Harvey.*

New Caledonia, New Hebrides, Fiji, and Samoa; also in Dammar and Timor Laut.

M. vitiensis, Gray, is probably the same as *M. odorata*, Forst.

TILIACEÆ.

Grewia Mallococca, Linn. f.—*Forster*; *Moseley*; *Lister*, and others.

Fiji, Samoa, and Society Islands.

Grewia prunifolia, A. Gray.—*Moseley.*

Fiji Islands.

Triumfetta procumbens, Forst.—*Mathews*; *Harvey*; *Home*; *Græffe*; *Cartwright.*

Throughout western Polynesia, from New Caledonia to Fiji and Samoa. Also in the Seychelles, Diego Garcia, and the Keeling Islands, through the Malay Archipelago, and in Fitzroy Island off the coast of Queensland.

Elæocarpus cassinioides, A. Gray.—*U.S. Expl. Exped.*
Fiji Islands.

GERANIACEÆ.

Oxalis corniculata, Linn.—*Moseley*; *Cartwright.*
Dispersed in nearly all warm and temperate regions.

RUTACEÆ.

Evodia hortensis, Forst.—*Forster*; *Nelson*; *Home*; *Græffe*; *Lister.*
New Guinea, eastward to Samoa.

Micromelum pubescens, Blume, var. **glabrescens**, Oliver (M. minutum, *Seem.*).—*Forster*; *Moseley*; *Cartwright*; *Lister*, and others.
New Caledonia and Fiji Islands, and tropical Australia, through the Malay Archipelago, to India and China.

Citrus Decumana, Linn.—*U.S. Expl. Exped.*
Introduced and cultivated in the Fiji and Tonga Islands.

BURSERACEÆ.

Canarium Harveyi, Seem.—*Harvey*; *Lister.*
Restricted to the Tonga Islands.

SIMARUBEÆ.

Suriana maritima, Linn.—*Harvey*; *Mathews.*
Ellice and Phœnix groups eastward to the Society Islands; and widely spread on tropical sea-shores of both hemispheres, though hitherto not found in West Africa.

MELIACEÆ.

Vavæa amicorum, Benth.—*Barclay*; *Moseley*; *Cartwright*; *Lister*, and others.
Confined to the Tonga Islands.

Dysoxylum Richii, C. DC. (D. alliaceum, *Seem.* non *Blume*).—*Græffe*; *Forster*; *Barclay.*
Fiji and Navigator Islands.

Melia Azedarach, Linn.—*Lister.*
Introduced. China, India, and commonly cultivated and naturalized in other warm countries.

Carapa moluccensis, Lam. (C. obovata, *Blume*).—*Lister.*
Fiji, N. Australia, through Malaya to India; also in tropical Africa and Madagascar.

OLACINEÆ.

Villaresia samoense, Benth. et Hook. f.—*Lister*.
Samoa or Navigator Islands.

CELASTRINEÆ.

Gymnosporia vitiensis, Seem.—*Nelson*; *Lister*, and others.
Fiji eastward to the Society Islands.

RHAMNACEÆ.

Colubrina asiatica, Brongn.—*Lister*.
Throughout Polynesia from New Caledonia to the Marquesas and Sandwich Islands, and widely spread in the tropics of the Old World.

Alphitonia excelsa, Reiss.—*Home*; *Lister*.
New Caledonia eastward to the Marquesas Islands and Timor Laut, tropical Australia.

Cardiospermum Halicacabum, Linn.—*Harvey*.
Throughout Polynesia and throughout the tropical regions of the world.

SAPINDACEÆ.

Allophyllus Cobbe, Blume (Schmidelia Cobbe, *DC.*).—*Home*.
Samoa and Society Islands, Northern Australia, and tropical Asia.

Cupania glauca, Camb. (Guioa glauca, *Radlk.*).—*Lister*.
New Caledonia.

Ratonia falcata, Seem. (Cupania falcata, *A. Gray*).—*Moseley*.
Fiji Islands.

Ratonia stipitata, Benth. (Cupania lentiscifolia, *Pers.*).—*Forster*; *U.S. Expl. Exped.*
Samoa, Society Islands, and East Australia.

Pometia pinnata, Forst.—*Forster*.
Fiji, Samoa Islands, and New Guinea.

Dodonæa viscosa, Forst.—*Harvey*.
New Caledonia and Fiji eastward to the Society and Sandwich Islands. Tropical and subtropical regions of the world almost everywhere; also extending into some temperate countries, both north and south.

ANACARDIACEÆ.

Rhus taitensis, Guill. (R. simarubæfolia, *A. Gray, var. β.* taitensis, *Engl.*).—*U.S. Expl. Exped.*; *Lister.*

Fiji, Samoa, and Society Islands; also from the Philippines.

Spondias dulcis, Forst.—*Forster*; *U.S. Expl. Exped.*; *Lister.*

Fiji, Samoa, and Society Islands. Cultivated in India and the Mascarene Islands.

As limited by Engler the species extends to tropical America and the West Indies.

LEGUMINOSÆ.

Indigofera Anil, Linn.—*Moseley.*

Fiji to the Marquesas and Sandwich Islands. Commonly cultivated, and native country uncertain.

Indigofera tinctoria, Linn.—*Cartwright*; *Lister.*

Almost universally cultivated in tropical countries, and apparently indigenous both in Asia and Africa.

Tephrosia purpurea, Pers. (T. piscatoria, *Pers.*).—*Forster*, and others.

From Fiji to the Marquesas and Sandwich Islands; and now found in tropical regions generally.

Desmodium polycarpum, DC.—*Lister.*

From the Fijis to the Marquesas; North Australia to Japan, China, and the Himalayas; also in the Mascarene Islands and eastern tropical Africa.

Desmodium umbellatum, DC.—*U.S. Expl. Exped.*; *Lister.*

New Caledonia eastward to Samoa and the Marquesas Islands; also in North-eastern Australia through the Malay Archipelago to Burma and Ceylon; and in the Mascarene Islands and eastern tropical Africa. Naturalized in the West Indies.

Uraria lagopodioides, DC.—*Home*; *Lister.*

New Hebrides and Fiji to the Navigator Islands; also in N. Australia and through Malaya to India and China.

Abrus precatorius, Linn.—*U.S. Expl. Exped.*

Fiji to the Marquesas Islands. Universally spread in the tropics, and extending into some subtropical regions. It exists as an escape from gardens in the Sandwich Islands (Hildebrand, Fl. Haw. Isds. p. 98).

Clitoria Ternatea, H. B. K.—*Lister.*
Widely spread in tropical countries; but it is commonly cultivated, and uncertain where it is really indigenous.

Erythrina indica, Lam.—*U.S. Expl. Exped.*; *Lister.*
Fiji to the Marquesas Islands; and Eastern Australia, through Malaya to India. Often planted.

Erythrina ovalifolia, Roxb.—*Lister.*
Fiji and Samoa Islands, Java, and India.

Mucuna gigantea, DC.—*Harvey*; *Lister.*
Fiji eastward to the Marquesas and Sandwich Islands; also Eastern Australia and through Malaya to India.

There is some doubt respecting the specific identity of the specimens from the various localities.

Pueraria Thunbergiana, Benth.—*Lister.*
Solomon Islands and Buru, and very common in China and Japan. Cultivated in China for its fibre.

Canavalia ensiformis, DC., var. **turgida** (C. turgida, *R. Grah.*). —*U.S. Expl. Exped.*
From Fiji to the Marquesas Islands, and common nearly all over tropical Asia, Africa, and America, especially in maritime districts, but apparently wanting in Australia.

Canavalia obtusifolia, DC.—*Barclay*; *Lister.*
Fiji eastward to the Society Islands, and common on sandy coasts in nearly all tropical countries.

Phaseolus adenanthus, G. F. Mey. (P. truxillensis, *H. B. K.*). —*Moseley.*
Fiji eastward to the Society and Sandwich Islands, and cosmopolitan in the tropics.

Phaseolus Mungo, Linn.—*Barclay.*
Fiji and Samoa Islands, and throughout the tropics of the Old World. Extensively cultivated as a vegetable.

Vigna retusa, Walp. (V. lutea, *A. Gray*).—*Cartwright*; *Lister.*
Fiji eastward to the Society and Sandwich Islands. Widely

dispersed on tropical sea-shores in the Old World; and also found in the West Indies.

Dolichos Lablab, Linn. (Lablab vulgaris, *Savi*).—*Harvey*; *Moseley*; *Cartwright*.

New Caledonia and Fiji to the Society and Sandwich Islands; and tropics of the Old World, except Australia.

Derris uliginosa, Benth.—*U.S. Expl. Exped.*

A common sea-side climbing shrub, ranging from Polynesia, including New Caledonia, New Hebrides, and Fiji Islands, to Northern Australia, South-eastern Africa, Madagascar, India and China.

Inocarpus edulis, Linn. f.—*Græffe*; *Moseley*; *Lister*.

From the Fijis to the Marquesas, and in Malaya.

Mr. Lister also collected this in Christmas Island, off the west coast of Java, from whose specimens the figure in Hooker's 'Icones Plantarum,' t. 1837, was prepared.

Sophora tomentosa, Linn.—*U.S. Expl. Exped.*; *Græffe*.

Fiji to the Marquesas Islands, and generally diffused on tropical sea-coasts, and extending into some subtropical regions.

Cæsalpinia Bonducella, Fleming.—*Mathews*.

From New Caledonia eastward to the Marquesas and Sandwich Islands; also widely spread and often very common, especially near the sea, in tropical Asia Africa, and America.

Cæsalpinia pulcherrima, Sw.—*Lister*.

Cultivated and more or less wild in nearly all tropical countries except Australia; but it is uncertain where it is really indigenous, though probably in some part of the Old World.

Cassia occidentalis, Linn.—*Cartwright*; *Lister*.

Fiji to the Marquesas and Sandwich Islands; colonized. Tropical America, and also now common in tropical Asia and Africa, though probably of American origin.

Cassia Sophera, Linn.—*Forster*; *Home*.

New Caledonia and Fiji Islands. "Tropical Asia, Africa, and Australia, more rare in tropical America; in all continents most frequently only from cultivation, or escaped from cultivation, with some evidence of being really indigenous in Australia and more doubtfully so in Asia and America." (Bentham, in Trans. Linn. Soc. xxvii. p. 532.)

Cynometra grandiflora, A. Gray.—*Harvey*; *Lister.*
Fiji Islands only, where, however, it must be common as it is in all collections.

Entada scandens, Benth.—*Harvey*; *Lister.*
Fiji to Samoa, and cosmopolitan in the tropics.

Mimosa pudica, Linn.—*Barclay*; *Cartwright*; *Lister.*
Tropical America, and now a common weed in most parts of the Polynesian region. Naturalized also in many parts of tropical Africa and Asia.

Leucæna Forsteri, Benth.—*Cook*; *Mathews.*
Polynesia from New Caledonia to Tahiti.

Acacia laurifolia, Willd.—*Cook*; *Home*; *Lister.*
New Hebrides and New Caledonia to Samoa and Fiji.

Serianthes myriadenia, Planch.—*Mathews.*
Fiji and Navigator to the Society Islands.

RHIZOPHOREÆ.

Rhizophora Mangle, Linn.—*Lister.*
Coasts of tropical America generally, also in west tropical Africa. Perhaps accidentally introduced with ballast in the Tonga Islands, as well as in Stewart Island—see *Ann. k.-k. Naturh. Hofmus. Wien*, iii. p. 251.

Rhizophora mucronata, Lam.—*Harvey*; *Cartwright.*
New Caledonia, Fiji and Navigator Islands, Northern Australia, and throughout tropical Asia and Eastern Africa.

Bruguiera Rheedii, Blume.—*Forster*; *Cartwright.*
New Caledonia, Fiji and Navigator Islands. Common in the tropical mangrove swamps of many parts of the Old World.

COMBRETACEÆ.

Terminalia Catappa, Linn.—*U.S. Expl. Exped.*
Fiji to the Marquesas Islands. Tropical Asia, and planted in nearly all tropical countries.

Terminalia littoralis, Seem.—*Harvey*; *Lister* (var. *tomentella*).

New Caledonia, Fiji, Navigator, Marquesas, and Sandwich Islands, and throughout Malaya. Often planted in other tropical countries.

Lumnitzera coccinea, Wight et Arn.—*U.S. Expl. Exped.*; *Cartwright*; *Lister*.

New Caledonia, Fiji, and Navigator Islands, Northern Australia, Malaya, and India.

MYRTACEÆ.

Metrosideros polymorpha, Gaudich.—*Barclay*; *Beechey*.

New Caledonia and Fiji eastward to the Marquesas, Sandwich, and Pitcairn Islands; also in the Kermadec group.

As the specific name indicates, this is an exceedingly variable species, and it is spread all over Polynesia; yet it does not reach New Zealand, the home of the rest of the genus except the outlying South-African *M. angustifolia*, Sm.

Nelitris Forsteri, Seem.—*Mathews*; *Lister*.

Fiji and Navigator Islands.

This should perhaps be included in the following species.

Nelitris fruticosa, A. Gray.—*U.S. Expl. Exped.*; *Græffe*.

Fiji Islands.

Eugenia amicorum, A. Gray.—*Cook*; *Forster*; *Home*.

Fiji, Navigator, and Society Islands.

Eugenia corynocarpa, A. Gray.—*Home*.

Fiji and Navigator Islands.

Eugenia Jambolana, Lam.—*Cartwright*. Probably cultivated.

Widely spread in India and Malaya, both wild and cultivated, and extending to Australia.

Eugenia malaccensis, Linn.—*U.S. Expl. Exped.*

This fruit-tree, so generally cultivated in tropical countries, is regarded as indigenous in Polynesia by Seemann, Hillebrand, Drake del Castillo, and other writers on Polynesian botany.

Eugenia rariflora, Benth. (forma *parviflora*).—*Home*; *Lister*.

Fiji eastward to Gambier Island, in the Low Archipelago, and the Sandwich Islands.

Eugenia Richii, A. Gray.—*Harvey.*
Fiji Islands.

Barringtonia Butonica, Forst. (B. speciosa, *Linn. f.*).—*Forster*; *Mathews.*
New Caledonia eastward to Ducie Island in the Low Archipelago; shores of India, Malaya, Australia, Mascarene Islands, and it has also been recorded from Diego Garcia, Chagos Islands.

MELASTOMACEÆ.

Melastoma denticulatum, Labill.—*Lister.*
New Caledonia and Fiji eastward to the Society Islands. This has often been confused with the Asiatic *M. malabathricum*, Linn.

Memecylon Harveyi, Seem.—*Harvey*; *Lister.*
Restricted to the Tonga Islands.

LYTHRARIEÆ.

Pemphis acidula, Forst.—*Harvey*; *Lister.*
New Caledonia and Union group eastward to the Society and Sandwich Islands; and an exceedingly common sea-side shrub in many parts of the tropics of the Old World, including the eastern coast of Africa.

SAMYDACEÆ.

Homalium vitiense, Benth.—*Lister.*
Fiji Islands.

PASSIFLOREÆ.

Disemma cærulescens, Seem. Fl. Vit. p. 96, in nota.—*Cook.*
This differs very slightly from New-Zealand and Fijian species, and a revision of the group would probably result in the reduction of some of the forms described as species; therefore I forbear giving it a name under *Passiflora*, of which *Disemma* is now generally regarded as a section.

Carica Papaya, Linn.—*U.S. Expl. Exped.*
Cultivated and naturalized in Polynesia from Fiji to the Society and Sandwich Islands. A native of tropical America, from Florida to Brazil.

CUCURBITACEÆ.

Luffa cylindrica, Roem., β. **insularum**, Cogn. (L. insularum, *A. Gray*).—*Barclay*; *Moseley*.

Commonly cultivated throughout the tropics.

The form *L. insularum* extends from New Caledonia and Fiji to the Society Islands, and it also occurs in Malaya and Australia.

Momordica Charantia, Linn.—*Moseley*.

Fiji and Society Islands. Commonly cultivated and naturalized in tropical countries and probably indigenous only in tropical Africa.

Melothria Grayana, Cogn.—*Lister*.

Fiji, Samoa, and Society Islands.

Cucumis Melo, Linn. (Cucumis pubescens, *Willd.*).—*U.S. Expl. Exped.*

New Caledonia and Fiji eastward to the Marquesas and Sandwich Islands. Tropical Asia and Africa, and naturalized in other countries, including Polynesia.

FICOIDEÆ.

Tetragonia expansa, Murr.—*Lister*.

Japan, Australia, Tasmania, New Zealand, and South America.

Sesuvium Portulacastrum, Linn. (Trianthema polyandra, *Blume*).—*Forster*; *Lister*.

Society and Sandwich Islands. Common, especially on sandy sea-shores, throughout tropical and subtropical regions.

UMBELLIFERÆ.

Hydrocotyle asiatica, Linn.—*Barclay*; *Lister*.

Fiji, Samoa, and Sandwich Islands, and tropical and subtropical regions in both hemispheres.

Apium leptophyllum, F. Muell.—*Cartwright*.

East Australia, tropical South and Central America, W. Indies, and southern part of North America. A common weed of cultivation in warm countries.

ARALIACEÆ.

Panax fruticosum, Linn. (Nothopanax fruticosum, *Miq.*).—*Home.*

Fiji Islands. India and Malaya, cultivated; native country uncertain.

Panax multijugum, Benth. et Hook. f. (Nothopanax multijugum, *Seem.*).—*Lister.*

Fiji Islands.

Meryta macrophylla, Seem.—*U.S. Expl. Exped.*; *Lister.*

Navigator Islands.

RUBIACEÆ.

Nauclea Forsteri, Seem.—*Lister.*

Society Islands.

Badusa corymbifera, A. Gray.—*Forster*; *Lister,* and others.

Fiji Islands.

Bikkia grandiflora, Reinw. (B. tetrandra, *A. Gray*, B. australis, *DC.*).—*Mathews*; *Harvey*; *Lister.*

New Hebrides and Loyalty Islands eastward to the Society and Low Islands; also from the Solomon Islands, New Guinea, and Java. It varies exceedingly in the size and shape of the flowers and to a less extent in the foliage.

Oldenlandia fœtida, Forst.—*Forster*; *Græffe.*

Savage Island, Navigator group, and Palmerston in the Hervey group.

Oldenlandia paniculata, Linn.—*Forster*; *Nelson*; *Moseley*; *Lister.*

New Hebrides and Fiji to the Navigator Islands; and generally diffused in tropical Asia.

Mussænda frondosa, Linn.—*Forster*; *Harvey*; *Græffe*; *Lister.*

From the Solomon Islands eastward to the Society Islands, and through Malaya to India and China.

Randia coffæoides, Benth. et Hook. f. (Stylocoryne coffæoides, *A. Gray*).—*Barclay*; *Harvey*; *Moseley*, and others.

New Hebrides, Fiji, and Society Islands.

Tarenna sambucina, T. Durand (Stylocoryne sambucina, *A. Gray*).—*Forster*; *Barclay*; *Cartwright*; *Lister.*

Fiji, eastward to the Society Islands.

Gardenia taitensis, DC.—*Forster*; *Græffe*; *Cartwright*; *Lister.*

Fiji to the Society and Marquesas Islands.

Guettarda speciosa, Linn.—*Cook*; *Harvey*; *Lister,* and others.

Tropical shores in the Old World, extending to the remotest islands of the Pacific.

Plectronia barbata, Benth. et Hook. f. (Canthium barbatum, *Seem.*).—*Forster*; *Lister.*

Fiji, Society and Marquesas, Pitcairn and Elizabeth Islands.

Plectronia odorata, Benth. et Hook. f. (Canthium odoratum, *Seem.*).

New Hebrides eastward to the Low Archipelago and Sandwich Islands, including many of the smaller islands.

Morinda citrifolia, Linn.—*Forster*; *Lister,* and others.

Fiji and Union group eastward to the Marquesas and Sandwich Islands, and widely diffused in tropical Asia, north-east Australia, and tropical Africa, chiefly in maritime districts. Common on many of the small low islands of the Pacific.

Morinda Forsteri, Seem.—*Home*; *Lister.*

Throughout Polynesia from New Caledonia to Pitcairn Island, though not recorded from the Sandwich Islands.

Psychotria amicorum, Benth. et Hook. f., *ex Drake, Ill. Fl. Ins. Mar. Pacif.* p. 197. (Chasalia amicorum, *A. Gray, in Proc. Am. Acad.* iv. p. 43; Psychotria asiatica, *Forst. f. Fl. Ins. Austr. Prodr.* p. 16, *non Linn.*; Petesia carnea, *Forst. f. Fl. Ins. Austr. Prodr.* p. 10, *et ic. ined. in Mus. Brit., sed non Gaertn. Fruct.* iii. p. 66, t. 192, *et ergo non* Eumachia carnea, *DC. Prodr.* iv. p. 479.) —*Forster*; *Harvey*; *Lister.*

Common in the Fiji Islands, and also found in Samoa.

This has been confused with *Psychotria Forsteriana,* A. Gray, Proc. Am. Acad. iv. p. 44 (*Petesia carnea,* Gaertn., *Eumachia carnea,* DC.), a native of the Fijis and Samoa, but hitherto not found in the Tonga group. The two plants are exceedingly alike in foliage, though very different in flower and fruit.

Psychotria insularum, A. Gray.—*U.S. Expl. Exped.*
Fiji, Samoa, and Society Islands.

Psychotria macrocalyx, A. Gray.—*U.S. Expl. Exped.*
Fiji Islands.

Geophila reniformis, D. Don.—*Lister.*
Fiji to the Society Islands, and through Malaya to India and S. China; also in tropical Africa and America.

COMPOSITÆ.

Vernonia insularum, Benth. et Hook. f. (Monosis insularum, *A. Gray*).—*U.S. Expl. Exped.*
Fiji Islands.

Erigeron albidus, A. Gray.—*Harvey*; *Lister*, and others.
Fiji to the Marquesas and Sandwich Islands, though originally from tropical America.

This is usually included under *E. bonariensis*, Linn., which is widely dispersed in tropical America.

Siegesbeckia orientalis, Linn.—*Moseley*; *Lister.*
Fiji to the Marquesas and Sandwich Islands, and cosmopolitan in warm countries and extending into some temperate regions.

Adenostemma viscosum, Forst.—*Moseley.*
Fiji to the Marquesas and Sandwich Islands, and almost everywhere in warm countries, but probably native in the Old World.

Dichrocephala latifolia, DC.—*Cook.*
Fiji, Society, and Marquesas Islands; also tropical and subtropical Asia and Africa.

Wedelia biflora, DC.—*Moseley.*
New Hebrides, Fiji, and Navigator Islands.

A common sea-side plant in the tropical regions of the Old World.

Wedelia strigulosa, Benth. et Hook. f. (Wollastonia strigulosa, *DC.*).—*Home*; *Moseley*; *Lister*, and others.
From New Caledonia to the Navigator Islands and in the Moluccas.

Bidens pilosa, Linn.—*Forster*; *Moseley*; *Lister.*

Fiji eastward to the Marquesas and Sandwich Islands, and generally spread in warm countries.

Sonchus asper, Vill.—*Forster*; *Barclay.*

Fiji, Society, and Sandwich Islands. All temperate and many tropical countries, wild or introduced.

Sonchus oleraceus, Linn.—*Moseley.*

The Marquesas and Sandwich Islands. Distribution of *S. asper.*

GOODENIACEÆ.

Scævola floribunda, A. Gray.—*U.S. Expl. Exped.*

Fiji Islands.

Scævola Kœnigii, Vahl, including *S. sericea*, Forst.—*Cook*; *Forster*; *Moseley*; *Lister.*

Fiji and Union group eastward to the Low Archipelago and Sandwich Islands; also tropical Asia and Australia.

CAMPANULACEÆ.

Wahlenbergia gracilis, A. DC.—*Lister.*

New Caledonia, New Zealand and the Kermadecs, Australia, India, Eastern Asia, and S. Africa.

MYRSINEÆ.

Mæsa nemoralis, DC.—*Cook*; *Lister.*

The Solomon Islands, New Caledonia, New Hebrides, Fiji and Navigator Islands.

Mæsa vitiensis, Seem.—*Lister.*

Fiji Islands.

Ardisia Listeri, Stapf, n. sp.—*Lister.*

See description, p. 214.

SAPOTACEÆ.

Bassia amicorum, A. Gray.—*Forster*; *Nelson*; *Lister.*

Only recorded from the Tonga Islands.

Mimusops Kauki, Linn. (M. dissecta, *R. Br.*).—*Forster.*

In Polynesia only known from the Tonga Islands; it occurs also in tropical Australia, Malaya, and Burma.

Isonandra Richii, A. Gray.—*U.S. Expl. Exped.*

Seemann (Fl. Vit. p. 150) states that this may prove conspecific with *Mimusops Kauki*, Linn. He also mentions that there was an undetermined species of this order in the British Museum, collected by Cook.

EBENACEÆ.

Maba buxifolia, Pers.—*Lister.*

This is the first record from Polynesia. Occurs also in North Australia, Malaya, India, tropical Africa, and Madagascar.

Maba elliptica, Forst.—*Forster*; *Harvey*; *Lister*, and others.

New Caledonia, Fiji, and Samoa.

OLEACEÆ.

Jasminum didymum, Forst. f.—*Græffe*; *Lister.*

New Caledonia and Fiji eastward to the Society Islands, and from Northern Australia to Java.

Jasminum simplicifolium, Forst. f. (J. australe, *Pers.*).—*Forster*; *Moseley*; *Lister*, and others.

New Hebrides and Fiji; also the east coast of Australia and Norfolk Island.

APOCYNACEÆ.

Melodinus scandens, Forst.—*Forster*; *Nelson*; *Lister.*

New Caledonia and Fiji.

Alyxia bracteolosa, Rich.—*Nelson*; *U.S. Expl. Exped.*

Fiji and Samoa Islands.

Alyxia scandens, Roem. et Schult.—*Lister.*

Fiji, Society, and Low Islands.

Alyxia stellata, Roem. et Schult.—*Forster*; *Nelson*; *Moseley*; *Lister.*

New Caledonia, Fiji and Society Islands, Malaya and tropical Asia.

Cerbera Odollam, Gaertn.—*Lesson*; *Moseley.*

Society, Marquesas, and Low Islands.

A sea-side tree of Polynesia, tropical Australia, and Asia.

Ochrosia parviflora, Hensl.—*Nelson*; *Harvey.*

New Caledonia and Fiji to the Society Islands; it also occurs in the Keeling Islands, where it was first collected by Darwin.

Vinca rosea, Linn.—*Lister.*
Samoa and Sandwich Islands. Supposed to be a native of tropical America; but it is now so firmly established in many parts of the Old World as to have all the appearance of being indigenous.

Tabernæmontana orientalis, R. Br.—*Nelson*; *Lister.*
New Hebrides, Fiji, Loyalty, and Society Islands; also eastern Australia and the Philippines.

ASCLEPIADACEÆ.

Asclepias curassavica, Linn.—*Moseley*; *Lister.*
Society, Marquesas, and Sandwich Islands; a native of the West Indies, now spread all over the tropics.

Hoya australis, R. Br. (H. bicarinata, *A. Gray*).—*U.S. Expl. Exped.*; *Lister.*
New Hebrides, Fiji, and Navigator Islands, and Eastern Australia.

LOGANIACEÆ.

Geniostoma crassifolium, Benth.—*Lister.*
Previously only known at Kew from the Philippines.

Geniostoma rupestre, Forst.—*Nelson*; *Barclay*; *Græffe.*
New Caledonia eastward to the Society Islands.

Fagræa Berteriana, A. Gray.—*Moseley*; *Lister.*
New Caledonia eastward to the Marquesas Islands.

BORAGINEÆ.

Cordia aspera, Forst.—*Forster*; *Nelson.*
Fiji and Navigator Islands.

Cordia subcordata, Lam.—*Barclay*; *Harvey*; *Macrae.*
From the Fiji and the Union group to the Marquesas and Sandwich Islands, coast of tropical Australia, Malaya, Islands of the Indian Ocean, westward to the east coast of Africa. In India it is commonly planted and perhaps nowhere really wild.

Tournefortia argentea, Linn. f.—*Forster*; *Lister.*
Fiji and Union group, eastward to the Society and Low Islands, and on nearly all coasts, insular and continental, of the Indian and Pacific Oceans, at least in the warmer parts.

CONVOLVULACEÆ.

Ipomœa biloba, Forsk. (I. Pes-capræ, *Roth*).—*Moseley*; *Lister*, and others.

Fiji to the Marquesas and Sandwich Islands, and almost everywhere on sandy coasts in tropical and subtropical regions.

Ipomœa Bona-nox, Linn. (Calonyction speciosum, *Choisy*).—*Nelson*; *Moseley*.

Fiji to the Society and Sandwich Islands. Now widely dispersed in tropical countries, often planted; but supposed to be a native of tropical America.

Ipomœa coccinea, Linn.—*Moseley*; *Lister*.

Also introduced into the Sandwich Islands. Cultivated and quasi-wild throughout India. Introduced from tropical America.

Ipomœa congesta, R. Br. (Pharbitis insularis, *Choisy*; I. insularis, *Steud.*).—*Nelson*; *Mathews*; *Moseley*.

New Hebrides; Fiji and Sandwich Islands. Also on the east coast of Australia, Norfolk and the Marianne Islands.

Ipomœa denticulata, Choisy.—*Barclay*; *Mathews*; *Moseley*.

New Hebrides, Fiji and Society Islands, Australia, Malaya, India, and the Seychelles.

Ipomœa martinicensis, G. F. W. Mey. (I. uniflora, *Roem. et Schult.*).—*Lister*.

Fiji; and widely dispersed in tropical Asia, Africa, America, and Australia.

Ipomœa peltata, Choisy.—*Lister*.

Fiji and Society Islands, East Australia, Malaya, and Mascarene Islands.

Ipomœa Turpethum, R. Br.—*Forster*; *Nelson*; *Mathews*.

Fiji, Samoa, and Society Islands, and North Australia through Malaya and the islands of the Indian Ocean to the Himalayas and Formosa.

SOLANACEÆ.

Solanum amicorum, Benth.—*Forster*; *Nelson*, and others.

Confined to the Tonga Islands.

Solanum Uporo, Dun. (S. anthropophagorum, *Seem.*; S. viride, *Soland.* non *R. Br.*).—*Barclay*; *Lister*.

New Caledonia, Fiji, Samoa, and Society Islands.

Solanum Forsteri, Seem.—*Barclay.*
Easter Island and Tahiti.

Solanum oleraceum, Dunal.—*Cartwright.*
Fiji, Union, Samoa, and Sandwich Islands.
This is now generally regarded as a variety of the cosmopolitan *S. nigrum*, Linn.

Solanum viride, R. Br.—*Nelson.*
Society and Marquesas Islands.

Physalis peruviana, Linn.—*Moseley.*
Society, Marquesas, and Sandwich Islands.
Indigenous in tropical America; extensively cultivated in the Old World, and widely colonized.

Capsicum frutescens, Linn.—*Moseley*; *Lister.*
Probably indigenous only in America; now cultivated and naturalized in most other warm countries.

GESNERACEÆ.

Cyrtandra Listeri, Hemsl., n. sp.—*Lister.*
For description see forward, p. 213.

ACANTHACEÆ.

Hemigraphis reptans, T. And.—*Moseley.*
New Caledonia, New Hebrides, and Admiralty Islands.

Eranthemum insularum, A. Gray.—*Harvey.*
Fiji Islands.

Graptophyllum Siphonostena, F. von Muell.—*Lister.*
Fiji Islands.
For description of this species see forward, p. 214.

VERBENACEÆ.

Premna taitensis, Schau.—*Harvey*; *Lister.*
Admiralty, Ellice, and Fiji, eastward to the Marquesas Islands.

Vitex trifolia, Linn.—*Forster*; *Moseley.*
Fiji, Marquesas, and Sandwich Islands, and a common sea-side shrub in the tropics of the Old World.

Clerodendron amicorum, Seem. (Faradaya amicorum, *Seem.*).—*Banks & Solander*; *Barclay*; *Harvey*; *Lister.*
Navigator Islands only.

Clerodendron inerme, R. Br.—*Mathews*; *Harvey*; *Moseley*; *Lister*.

New Caledonia, Fiji and Navigator Islands, and a common sea-side shrub in tropical Asia and Australia.

LABIATÆ.

Ocimum Basilicum, Linn.—*Home*; *Lister*.

Fiji, Society, Marquesas, and Sandwich Islands, introduced. Widely diffused in tropical Asia and Africa, and commonly cultivated.

Ocimum gratissimum, Linn.—*Moseley*. (Introduced.)

Java, India, tropical Africa and America; commonly cultivated.

Leucas flaccida, R. Br. (including *L. decemdentata*, Sm.).—*Lister*.

Fiji, Society, and Marquesas Islands, and Eastern Australia, Malaya, India. Colonized in the West Indies.

Teucrium inflatum, Sw.—*Forster*; *Barclay*; *Græffe*, and others.

New Caledonia, New Hebrides, and Fiji, and widely dispersed in tropical and subtropical America and the West Indies. Also in the Galapagos.

NYCTAGINEÆ.

Pisonia inermis, Forst.—*Harvey*; *Lister*.

Throughout Polynesia, from Fiji to the Low Archipelago and Sandwich Islands. Also North-east Australia.

The Polynesian and Australian species of *Pisonia* have been so variously limited by different authors, that it is difficult to understand them, except on the assumption that there is one very variable species. Indeed, Drake del Castillo (Flore de la Polynésie Française, p. 157) unites them all, except *P. aculeata*, Linn., under the name of *P. umbellifera*, Seem. (*Ceodes umbellifera*, Forst.), and doubtless the only alternative is to make several, or even many, critical species.

AMARANTACEÆ.

Amarantus caudatus, Linn. (Euxolus caudatus, *Moq*.).—*Cook*.

Fiji, Society, and Sandwich Islands; and widely dispersed in the warmer parts of Asia; also occurring in tropical Africa.

Amarantus paniculatus, Linn.—*Barclay.*

Fiji, cultivated or an escape in East and West Asia and Africa. A common weed in the warm countries of the Old World.

Achyranthes aspera, Linn.—*Barclay*; *Moseley*; *Lister.*

Fiji and Society Islands, and generally diffused in Eastern Australia, tropical and subtropical Asia, Africa, and America.

Cyathula prostrata, Blume.—*Barclay.*

New Hebrides and Solomon Islands to Tahiti and the Marquesas; and widely spread in tropical Asia and East Africa.

Gomphrena globosa, Linn.—*Barclay.*

Probably a native of America, now naturalized in nearly all hot countries.

CHENOPODIACEÆ.

Salsola Kali, Linn.—*Moseley.*

Very widely diffused in temperate and subtropical regions, both in America and in the Old World, where the soil is impregnated with salt.

PHYTOLACCACEÆ.

Rivina humilis, Linn. (R. lævis, *Linn.*).—*Lister.*

Exceedingly common in tropical and subtropical America, and naturalized in many parts of the Old World, including Polynesia.

POLYGONACEÆ.

Polygonum glabrum, Willd.—*Lister.*

Fiji, Society, and Sandwich Islands; also tropical Asia, Africa, and America.

PIPERACEÆ.

Piper latifolium, Forst. f.—*Forster*; *Moseley.*

New Hebrides, Fiji and Society Islands; also from Timor.

Piper Macgillivrayi, C. DC.—*Nelson*; *Barclay*; *Moseley*; *Lister*, and others.

Fiji and Society Islands, common.

Piper methysticum, Forst. f.—*Home*; *Lister.*

Cultivated and spontaneous in Fiji, Society, Marquesas, and Sandwich Islands.

Peperomia leptostachya, Hook. et Arn.—*Lister.*
Society, Marquesas, and Sandwich Islands; also North-east Australia.

MYRISTICACEÆ.

Myristica hypargyræa, A. Gray.—*U.S. Expl. Exped.*; *Lister.*
Navigator Islands.

Myristica inutilis, Rich.—*U.S. Expl. Exped.*
Navigator Islands.

MONIMIACEÆ.

Hedycarya ? alternifolia, Hemsl., n. sp.—*Lister.*
Confined to the Tonga Islands. Better specimens are required. For description see forward, p. 215.

Hedycarya dorstenioides, A. Gray.—*Lister.*
Fiji and Navigator Islands; apparently very common.

LAURINEÆ.

Cassytha filiformis, Linn.—*Lister.*
Fiji, Union, and Phœnix, eastward to the Society, Low, and Sandwich Islands, and very widely diffused, chiefly in maritime districts, in tropical Asia, Africa, America, and Australia.

Hernandia Mœrenhoutiana, Guill.—*Moseley*; *Lister.*
Society Islands.

Hernandia peltata, Meissn.—*Home.*
Fiji, Union, Society, and Marquesas Islands; also in North Australia, tropical Asia, East Africa, and Madagascar.

THYMELÆACEÆ.

Wikstrœmia rotundifolia, Decne.—*Nelson*; *Harvey*; *Lister.*
Confined to the Tonga Islands.

Leucosmia acuminata, A. Gray (Drimyspermum acuminatum, *Seem.*).—*Forster*; *Nelson*; *Lister.*
Fiji and Navigator Islands.

Leucosmia Burnettiana, Benth. (Drimyspermum Burnettianum, *Seem.*).—*Harvey*; *Lister.*
Fiji and Navigator Islands.

LORANTHACEÆ.

Loranthus insularum, A. Gray.—*U.S. Expl. Exped.*; *Moseley*; *Lister*.

Fiji, Samoa, and Society Islands.

EUPHORBIACEÆ.

Euphorbia Atoto, Forst.—*Cook*; *Forster*; *Lister*.

New Caledonia and Fiji eastward to the Marquesas and Sandwich Islands. A sea-side shrubby species, also inhabiting the coasts of North Australia, Malaya, and India.

Euphorbia obliqua, Endl.—*Forster*.

Norfolk Island.

Euphorbia pilulifera, Linn.—*Moseley*; *Cartwright*.

Fiji, Society, Marquesas, and Sandwich Islands. Now generally diffused in warm regions of both hemispheres.

Euphorbia Sparmannii, Boiss.—*Lister*.

Pitcairn and Elizabeth Islands and New South Wales. This is similar to some of the other species and probably occurs in intermediate localities.

Phyllanthus Gaudichaudii, Muell. Arg.—*U. S. Expl. Exped.*

Samoa and Marianne Islands.

Phyllanthus ramiflorus, Muell. Arg.—*Cook*; *Lister*.

New Hebrides and Fiji eastward to the Society and Marquesas Islands.

Phyllanthus simplex, Retz.—*Cook*; *Barclay*; *Lister*.

New Caledonia and Fiji, Samoa and Society Islands, and Australia, Malaya, India, China, and Mongolia.

Codiæum variegatum, Blume (C. moluccanum, *Decne.*).—*Lister*

New Hebrides and Solomon Islands to Fiji and Navigator Islands, and in the Moluccas; cultivated in many countries.

This is an exceedingly variable plant in its foliage. Seemann (Fl. Vit. p. 231) states that it forms underwood in the larger islands of the Fiji group, where it was, even in his time, commonly cultivated by the natives for ornamental purposes. A great many varieties were cultivated, each having a distinguishing name. Hillebrand (Fl. Haw. p. 393) mentions it as a cultivated plant only in the Sandwich Islands. Drake del Castillo does not mention it, and I find no Tahitian specimens.

Bischofia javanica, Blume.—*Harvey.*
New Caledonia eastward to the Society Islands; also Malaya and India.

Bischofia leptopoda, Muell. Arg. (ex descr.).—*Moseley.*
Samoa.

Aleurites moluccana, Willd. (including *A. triloba*, Forst.).—*Forster*; *Barclay*; *Moseley*; *Cartwright*; *Lister.*
Generally spread in Polynesia; also North-eastern Australia, Malaya, and India. It is now naturalized in most other tropical countries.

Acalypha grandis, Benth.—*Home*; *Hombron.*
New Hebrides to the Navigator Islands and the Malay Archipelago.

Acalypha insulana, Muell. Arg.—*Moseley.*
Fiji and Navigator Islands.

Macaranga Harveyana, Muell. Arg.—*Harvey*; *Moseley*; *Cartwright*; *Lister.*
Fiji, Navigator, and Society Islands.

Macaranga Seemannii, Muell. Arg.—*Cook.*
Fiji Islands.

Ricinus communis, Linn.—*Moseley.*
Cultivated and subspontaneous in the Fiji, Society, Marquesas, and Sandwich Islands, and very generally spread in tropical and subtropical regions. It is uncertain where it is really indigenous; but Africa is regarded as its native home.

Homalanthus pedicellatus, Benth. (H. nutans, *Benth. et Hook. f.*; Carumbium pedicellatum, *Miq.*; C. nutans, *Muell. Arg.*).—*Forster*; *Barclay*; *Lister*, and others.
New Caledonia, New Hebrides, Fiji, and Society Islands.

Excœcaria Agallocha, Linn.—*Cook*; *Home.*
New Caledonia and Fiji Islands, North-eastern Australia, Malay Archipelago, and the coasts of tropical India.

URTICACEÆ.

Celtis pacifica, Planch.—*Cook.*
Only recorded from the Marquesas and Tonga Islands.

Trema amboinensis, Blume.—*Græffe.*

Fiji and Sandwich Islands, and widely spread from North and East Australia, through Malaya, northward to South China and India.

Trema discolor, Benth. et Hook. f. (Sponia discolor, *Decne.*).—*Moseley.*

Society Islands.

Broussonetia papyrifera, Vent.—*Home.*

Fiji, Society, Marquesas, and Sandwich Islands, New Zealand, Malaya, India, and Formosa; but often cultivated.

Ficus aspera, Forst. f.—*Moseley.*

New Hebrides, Fiji Islands, and East Australia.

Ficus prolixa, Forst. f. (F. Forsteriana, *Endl.*).—*Forster.*

New Caledonia, New Hebrides, Society, and Marquesas Islands.

Ficus scabra, Forst. f.—*Home.*

New Hebrides and Fiji Islands.

Ficus Storckii, Seem.—*Barclay.*

Fiji Islands. Known only from Kadavu.

Ficus tinctoria, Forst. f.—*Home*; *Lister.*

Fiji, Samoa, and Society Islands.

Antiaris Bennettii, Seem.—*Home.*

Fiji, and Tucopia Island, near the New Hebrides.

Fleurya interrupta, Gaudich.—*Cook*; *Moseley.*

From the Solomon Islands and New Hebrides to the Marquesas and Sandwich Islands; also North-eastern Australia through Malaya to China and India, and in Eastern Africa.

Laportea Harveyi, Seem.—*Lister.*

Fiji Islands.

Elatostemma sesquifolium, Hassk. (Procris integrifolia, *D. Don*, non *Hook. et Arn.*).—*Lister.*

India and Malaya.

Pipturus argenteus, Wedd. (P. propinquus, *Wedd.*).—*Forster*; *Lister.*

New Hebrides eastward to the Society and Marquesas Islands, and in North-eastern Australia and the Malay Archipelago.

Pipturus velutinus, Wedd. (Sponia velutina, *Planch.*; P. incanus, *Wedd.*).—*Cook*; *Græffe.*

From the New Hebrides and the Ellice group to the Marquesas; also in the Malay Archipelago and the Nicobar Islands.

[There is a specimen of *Bœhmeria platyphylla*, D. Don, in the Kew Herbarium labelled "Tongatabou and Tahiti," but it was probably from the latter island.]

CASUARINEÆ.

Casuarina equisetifolia, Forst.—*Home*; *Cartwright.*

Fiji, Society, and Marquesas Islands, and generally spread in the coast-regions of tropical Asia, Africa, and Australia. It is naturalized in tropical America.

HYDROCHARIDEÆ.

Halophila ovata, Gaudich. (H. ovalis, *Hook. f.*).—*Home*; *Moseley.*

In the sea: Fiji and Navigator Islands, and widely spread in the Indian and Pacific Oceans.

ORCHIDEÆ.

Dendrobium macranthum, A. Rich.—*Lister.*

Solomon Islands, New Guinea, and Java.

Spathoglottis pacifica, Reichb. f.—*Græffe*; *Lister.*

Fiji, Samoa, and the Society Islands.

Corymbis veratrifolia, Reichb. f.—*Moseley.*

Fiji and Samoa Islands, North Australia, through Malaya to the Philippines and India.

SCITAMINEÆ.

Canna indica, Linn.—*Barclay*; *Lister.*

Fiji, Samoa, and Sandwich Islands, Malaya, India, and Tropical America.

Hillebrand (Fl. Haw. p. 435) states that this plant is now spread all over the islands, but he suspected that it was introduced soon after the discovery of the islands, yet it has a native name.

AMARYLLIDEÆ.

Crinum pedunculatum, R. Br. (C. taitense, *Red.*).—*Lister.*

New Caledonia, Fiji, Eastern Australia, and Malaya.

TACCACEÆ.

Tacca pinnatifida, Forst.—*Moseley.*

Fiji to the Marquesas and Sandwich Islands, and widely diffused in maritime districts of tropical Asia and Africa, as well as on the coast of North-eastern Australia.

DIOSCOREACEÆ.

Dioscorea alata, Linn.—*Cook.*

Fiji, Society, and Marquesas Islands, also Malaya and tropical India, though perhaps not indigenous in the last-named country.

Dioscorea sativa, Linn.—*Cook.*

Fiji eastward to the Marquesas and Sandwich Islands, North-eastern Australia, through Malaya to India and Africa.

LILIACEÆ.

Cordyline terminalis, Kunth.—*Moseley*; *Lister.*

Fiji, Society, Marquesas, and Sandwich Islands, and generally spread over tropical Asia and North-eastern Australia.

Dianella ensifolia, Red.—*Lister.*

New Caledonia, Fiji and Sandwich Islands, Australia, tropical Asia, and the Mascarene Islands.

Dianella intermedia, Endl.—*Nelson.*

Fiji and Society Islands, also New Zealand and Norfolk Islands. The synonymy of these two species is variously quoted by different authors.

COMMELINACEÆ.

Commelina nudiflora, Linn. (C. pacifica, *Vahl*).—*Forster*; *Nelson*; *Barclay.*

Fiji and Sandwich Islands, and generally diffused in warm countries.

PALMÆ.

Pritchardia pacifica, Seem. et H. Wendl.—*U.S. Expl. Exped.*; *Lister.*

Fiji, Samoa, and Marquesas Islands.

Cocos nucifera, Linn.—*Lister.*

Throughout tropical Polynesia and almost all littoral regions within the tropics. The cocoanut has long been cultivated in the most distant parts of the world, and it is uncertain how much of its present geographical range is due to the direct agency of man and where it spread from.

PANDANEÆ.

Pandanus odoratissimus, Linn. f. (P. verus, *Rumph.*).—*Cook.*

Fiji, Society, and Sandwich Islands, North Australia, and tropical Asia.

AROIDEÆ.

Raphidophora pertusa, Schott, var. **vitensis**, *Engl.* (Scindapsus Forsteri, *Endl.*; Epipremnum mirabile, *Schott*).—*Lister.*

New Hebrides, Fiji, and Society Islands.

The typical form is found in Eastern Australia, Malaya, and India.

NAIADACEÆ *.

Halodule australis, Miq.—*Moseley.*

Marianne Islands, New Caledonia, and the Fijis; also Malaya, India, Mascarene Islands, North Africa, Red Sea, and the Mediterranean.

CYPERACEÆ. [By C. B. Clarke, F.R.S.]

Mariscus albescens, Gaudich. (Cyperus stuppeus, *Forst. f.*; C. pennatus, *Lam.*).—*D'Urville*; *Moseley.*

Throughout Polynesia abundant; sparsely scattered through the tropics of the Old World, from Guinea to the Sandwich Islands.

Mariscus albescens, Gaudich., *var.* β. **ventricosa**, C. B. Clarke (Cyperus ventricosus, *R. Br.*; C. caricifolius, *Hook. et Arn.*; C. tongatabuensis, *Boeck.*).—*Home*; *Græffe.*

Australia and Sandwich Islands.

Mariscus cyperinus, Vahl, *var.* β. **venusta**, C. B. Clarke (M. umbellatus, *Horne*; Cyperus venustus, *Forst. f.* non *R. Br.*).—*Jensen.*

Throughout Polynesia; common.

Mariscus lævigatus, Hook. et Arn. *non* Roem. et Schult (M. flavus, *Seem.* non *Vahl*; Cyperus Seemannianus, *Boeck.*; C. upoluensis, *Boeck.*).—*Home.*

Fiji and Navigator Islands; plentiful.

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* Until this was in type I had overlooked a record of *Cymado cea isoetifolia* Aschers. (Engl. Jahrb. vii. p. 446), from Tonga. It inhabits the Indian and Pacific Oceans.

Kyllinga monocephala, Rottb.—*Moseley*; *Jensen*
Abundant in Polynesia, and a weed throughout the warmer parts of the Old World.

Fimbristylis complanata, Link (F. communis, *Seem.*).—*Græffe.*
Frequent in Polynesia and throughout the warmer parts of the world.

Fimbristylis cymosa, R. Br., *var. β.* **subcapitata**, C. B. Clarke (F. pycnocephala, *Hillebr.*).—*Græffe.*
New Caledonia to Sandwich Islands.

Fimbristylis diphylla, Vahl (F. affinis, *Presl*; F. marquesana, *Steud.*).—*Home*; *Moseley.*
Throughout Polynesia and the warmer parts of the world.

Scleria depauperata, Boeck.—*Harvey.*
From New Caledonia to Samoa; frequent.

Scleria lithosperma, Sw.—*Barclay.*
Common in Polynesia and throughout the warmer parts of the world.

GRAMINEÆ.

Paspalum scrobiculatum, Linn.—*Cook*; *Cartwright.*
New Hebrides, Fiji, Society, and Sandwich Islands, and frequent in tropical and subtropical Australia, Asia, and Africa.

Panicum ambiguum, Trin.—*U.S. Expl. Exped.*; *Harvey*; *Moseley.*
New Caledonia, Fiji and Navigator Islands; it is also recorded from the Philippine Islands.

Panicum pilipes, Nees.—*Barclay*; *Moseley.*
Fiji Islands.

Panicum sanguinale, Linn.—*Barclay*; *Home*; *Cartwright*; and others.
New Hebrides to the Society Islands and Pitcairn Island, and almost everywhere in tropical and subtropical countries.

Panicum trigonum, Retz.—*U.S. Expl. Exped.*
New Hebrides and the Fiji Islands, Malaya, and India.

Oplismenus Burmanni, Beauv.—*Lesson*; *Cartwright.*
Fiji Islands and tropical regions generally.

Oplismenus compositus, Roem. et Schult.—*Moseley.*
Fiji to the Marquesas, Sandwich, and Gambier Islands (Low Archipelago); and generally spread in warm countries.

Cenchrus calyculatus, Cav. (C. anomoplexis, *Labill.*).—*Home*; *Moseley.*
New Caledonia eastward to the Society, Sandwich, and Pitcairn Islands.

Coix Lacryma-Jobi, Linn.—*Forster*; *Moseley.*
Fiji and Society Islands, and now common in the tropics of both hemispheres. Probably introduced into the New World.

Erianthus maximus, Brongn. (Eulalia japonica, *Seem.* non *Trin.*, teste *Hackel*).—*U.S. Expl. Exped.*
Fiji and Society Islands.

Stenotaphrum americanum, Schrank.—*Barclay.*
Widely spread in Polynesia, though not cited by either Seemann or Drake del Castillo; and widely spread on tropical sea-shores in both hemispheres.

Thuarea sarmentosa, Pers. (T. involuta, *R. Br.*).—*Harvey.*
New Hebrides and Fiji to the Society Islands and Low Archipelago; and in the Mascarene Islands, Malay Archipelago, and North Australia.

Andropogon aciculatus, Retz.—*Home*; *Cartwright.*
From New Caledonia eastward to the Marquesas, Low, and Sandwich Islands, and in Australia, Malaya, China, India, and Mauritius.

Eleusine indica, Gaertn.—*Barclay*; *Home*; *Moseley*, and others.
Fiji to the Marquesas and Sandwich Islands, and almost everywhere in tropical and subtropical regions, and occurring in some temperate countries; often existing, however, as a colonist only.

Centotheca lappacea, Desv.—*Barclay.*
Fiji to the Society and Marquesas Islands, on the eastern coast of North Australia, and generally spread over tropical Asia and Africa.

GYMNOSPERMEÆ.

CONIFERÆ.

Podocarpus elata, R. Br.—*Harvey*; *Lister*.

East Australia, from Rockingham Bay, southward to the Macquarrie river.

CYCADACEÆ.

Cycas circinalis, Linn.—*Lister*.

Solomon Islands, New Caledonia, New Britain, Fiji, North Australia, Malaya, India, eastern tropical Africa, and the Mascarene Islands.

With a numerous series of specimens, both wild and cultivated, before us, Mr. W. T. Thiselton Dyer and I find it impossible to sort them satisfactorily into the proposed species: *C. circinalis*, L., *C. Rumphii*, Miq., and *C. celebica*, Miq., to say nothing of the half-a-dozen or more other forms which have been described as such; but it would, perhaps, be premature to unite them without studying them where they grow in abundance. *Cycas* is rare in Polynesia and unknown in the Society, Marquesas, and Sandwich groups, and most abundant in the Malay Archipelago.

FILICES.

Gleichenia dichotoma, Hook.—*Home*; *Lister*.

Fiji to the Marquesas and Sandwich Islands, and in tropical and subtropical regions generally.

Alsophila lunulata, R. Br.—*Lister*.

New Hebrides, Fiji, and Navigator Islands.

Davallia elegans, Sw.—*Lister*.

Society Islands, tropical Australia, Malaya, China, India, Madagascar, and western Tropical Africa.

Davallia solida, Sw.—*Home*; *Lister*.

Fiji and Society Islands, Java, and the Malayan Peninsula.

Adiantum Capillus-Veneris, Linn.—*Lister*.

Almost cosmopolitan, except in the colder regions.

Adiantum diaphanum, Blume.—*Lister*.

New Caledonia, Fiji and Navigator Islands, New Zealand, Australia, Malaya, and South-east China.

Adiantum hispidulum, Sw.—*Nelson.*
Fiji and Society Islands, and widely spread in tropical regions of the Old World.

Hypolepis tenuifolia, Bernh.—*Moseley*; *Lister.*
New Hebrides and Society Islands, New Zealand, Australia, and Java.

Pteris comans, Forst. f.—*Nelson*; *Lister.*
New Zealand, Tasmania, New Hebrides, Fiji, and Society Islands; also Juan Fernandez.

Pteris ensiformis, Burm. f. (P. crenata, *Sw.*).—*Cook*; *Nelson.*
Fiji and Navigator Islands, and tropical Australia to India and China.

Pteris longifolia, Linn.—*Nelson*; *Barclay*; *Home*; *Lister.*
New Hebrides and Fiji, and tropical and warm temperate regions all round the world.

Pteris marginata, Bory (P. tripartita, *Sw.*; Litobrochia tripartita, *Presl*).—*Lister.*
Fiji to Society Islands; and in Australia, Malaya, India, west tropical Africa, Mascarene Islands, and Kaffraria.

Pteris quadriaurita, Retz.—*Nelson*; *Home.*
New Hebrides, Fiji, and Sandwich Islands, and all round the world within the tropics and a little beyond them.

Blechnum orientale, Linn.—*Home.*
Fiji and Society Islands, Australia, India, and South China.

Asplenium falcatum, Lam.—*Nelson*; *Home*; *Barclay*; *Moseley.*
New Caledonia, Fiji, and Society Islands, and ranging widely in the tropical regions of the Old World.

Asplenium obtusatum, Forst. f.—*Lister.*
Society, Marquesas, and Sandwich Islands, New Zealand and Australia, and extending to Peru and Chili.

Aspidium aristatum, Sw.—*Lister.*
Fiji eastward to the Society and Sandwich Islands, and in Australia, Japan, Ceylon to the Himalayas, and in Natal.

Nephrodium dissectum, Desv.—*Home*; *Lister.*
New Caledonia eastward to the Society Islands, and in South-west Australia, tropical Asia, and Madagascar.

Nephrodium Hænkeanum, Presl.—*Nelson.*
Fiji, Samoa, and Society Islands, Malaya, and Ceylon.

Nephrodium Harveyi, Baker.—*Lister.*
Fiji, Samoa, and Society Islands.

Nephrodium invisum, Carruth.—*Home*; *Moseley.*
Common in the Polynesian islands, though not recorded from the Sandwich group.

Nephrodium latifolium, Baker.—*Lister.*
Fiji to the Society Islands.

Nephrodium molle, Desv. (N. nymphale, *Hook. et Arn.*).—*Nelson*; *Barclay.*
New Hebrides, Fiji, and Society Islands, and widely dispersed in tropical and subtropical regions.

Nephrolepis acuta, Presl, *var.* (N. rufescens, *Presl*).—*Moseley*; *Lister.*
New Hebrides, Fiji, and Society Islands, and widely dispersed in tropical and subtropical regions.

Nephrolepis exaltata, Schott.—*Nelson*; *Home*; *Lister.*
New Hebrides to the Marquesas and Sandwich Islands, and widely dispersed in tropical and subtropical regions.

Polypodium adnascens, Sw. (Niphobolus adnascens, *Kaulf.*).—*Nelson*; *Home*; *Barclay.*
Solomon and Fiji Islands, and common in the tropical regions of the Old World.

Polypodium nigrescens, Blume.—*Veitch.*
Fiji, Samoa, and Society Islands, East Australia, Malaya, and India.

Polypodium Phymatodes, Linn.—*Home*; *Moseley*; *Lister.*
Fiji, Society, and Marquesas Islands, and tropical and subtropical regions of the Old World.

Acrostichum aureum, Linn.—*Moseley.*
Fiji, Samoa, and Society Islands, and widely dispersed in tropical and subtropical regions of both hemispheres.

Schizæa dichotoma, Sw.—*Cook*; *Lister.*
Fiji and Society Islands, and widely dispersed in tropical and subtropical regions.

Ophioglossum pendulum, Linn.—*Moseley.*

Fiji, Society, and Sandwich Islands, and over the tropical regions of the Old World.

LYCOPODIACEÆ.

Lycopodium cernuum, Linn.—*Lister.*

Fiji, Society, and Sandwich Islands, and cosmopolitan in the tropics of both hemispheres and extending beyond them to Japan, the Azores, Cape Colony, New Zealand, and St. Paul's Island in the south Indian Ocean.

Psilotum triquetrum, Sw.—*Lister.*

Fiji, Society, and Sandwich Islands, and tropical regions of both hemispheres, extending to Florida, Japan, and New Zealand.

5. TABULAR VIEW *of the Distribution of the apparently Indigenous Plants of the Tonga or Friendly Islands.*

This Table is restricted to the plants concerning which there is some probability of their being indigenous—that is to say, those which have probably reached the islands without the direct agency of man; but of course this is a point from which uncertainty cannot be eliminated. Thus limited, about 50 species included in the Enumeration are not repeated here. The list itself is of plants collected in one or more of the Tonga Islands *. In the first column to the right of the name the star indicates whether the species is found in Polynesia westward of the Tonga Islands; and in the second column an eastward extension. It should be understood that Polynesia is here employed in a broad sense, and includes Micronesia and Melanesia of geographers. The third column, Australasia, includes Australia, New Zealand, and the contiguous islands belonging to these countries. Malaya, in the fourth column, includes New Guinea, the Moluccas, Malay archipelago and peninsula, Siam, and Cochin China. The fifth column indicates a wider range in the Old World, and the sixth an extension to America or the New World.

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* The Wallis Islands, claimed by the French, are here considered as forming part of the Tonga group; but very few plants have been collected in this group.

Tonga Islands.	Polynesia.		Australasia.	Malaya.	Of wider range.	
	West*.	East *.			Old World.	New World.
Stephania hernandiæfolia	...	*	*	*	*	
Cardamine sarmentosa	*	*	...	...	...	*
Melicytus ramiflorus	...	...	*			
Xylosma orbiculatum	*	*				
Pittosporum arborescens	*					
,, Brackenridgei	*					
,, rhytidocarpum	*					
Portulaca oleracea	*	*	*	*	*	*
,, quadrifida	*	*	*	*	*	
Garcinia sessilis	*					
Calophyllum spectabile	*	*	...	*	*	
Sida microphylla	*	*	...	*	*	
,, rhombifolia	*	*	*	*	*	*
,, spinosa	...	...	*	*	*	*
Urena lobata	*	*	*	*	*	*
,, morifolia	*					
Hibiscus tiliaceus	*	*	*	*	*	*
Thespesia populnea	*	*	*	*	*	
Heritiera littoralis	*	...	*	*	*	
Melochia odorata	*	*	...	*		
Grewia Mallococca	*	*				
,, prunifolia	*					
Triumfetta procumbens	*	*	*	*		
Elæocarpus cassinioides	*					
Evodia hortensis	*	*	...	*		
Micromelum pubescens	*	...	*	*	*	
Canarium Harveyi.—Endemic						
Suriana maritima	*	*	*	*	*	*
Vavæa amicorum.—Endemic						
Dysoxylum Richii	*					
Carapa moluccensis	*	...	*	*	*	
Villaresia samoense	...	*				
Gymnosporia vitiensis	*	*				
Colubrina asiatica	*	*	*	*	*	
Alphitonia excelsa	*	*	*	*		
Cardiospermum Halicacabum	*	*	*	*	*	*
Allophyllus Cobbe	...	*	*	*	*	
Cupania glauca	*					
Ratonia falcata	*					
,, stipitata	...	*	*			
Pometia pinnata	*	*	...	*		
Dodonæa viscosa	*	*	*	*	*	*
Rhus taitensis	*	*	...	*		
Spondias dulcis	*	*				
Tephrosia purpurea	*	*	*	*	*	*
Desmodium polycarpum	*	*	*	*	*	
,, umbellatum	*	*	*	*	*	
Uraria lagopodioides	*	*	*	*	*	
48	40	31	24	28	22	10

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* West or east of the Tonga Islands.

Tonga Islands.	Polynesia.		Australasia.	Malaya.	Of wider range.	
	West.	East.			Old World.	New World.
48	40	31	24	28	22	10
Abrus precatorius	*	*	*	*	*	*
Erythrina indica	*	*	*	*	*	
„ ovalifolia	*	*	...	*	*	
Mucuna gigantea	*	*	*	*	*	
Pueraria Thunbergiana	*	...	...	*	*	
Canavalia ensiformis	*	*	...	*	*	*
„ obtusifolia	*	*	*	*	*	*
Vigna retusa	*	*	*	*	*	*
Dolichos Lablab	*	*	...	*	*	
Derris uliginosa	*	...	*	*	*	
Inocarpus edulis	*	*	...	*		
Sophora tomentosa	*	*	*	*	*	*
Cæsalpinia Bonducella	*	*	*	*	*	*
Cynometra grandiflora	*					
Entada scandens	*	*	*	*	*	*
Leucæna Forsteri	*	*				
Acacia laurifolia	*	*				
Serianthes myriadenia	*	*				
Rhizophora Mangle	...	...	...	...	*	*
„ mucronata	*	*	*	*	*	
Bruguiera Rheedii	*	*	*	*	*	
Terminalia Catappa	*	*	...	*	*	
„ littoralis	*	*	...	*		
Lumnitzera coccinea	*	*	*	*	*	
Metrosideros polymorpha	*	*	*			
Nelitris fruticosa	*					
„ Forsteri	*	*				
Eugenia amicorum	*	*				
„ corynocarpa	*	*				
„ malaccensis	*	*	...	*	*	
„ rariflora	*	*				
„ Richii	*					
Barringtonia Butonica	*	*	*	*	*	
Melastoma denticulatum	*	*				
Memecylon Harveyi.—End.						
Pemphis acidula	*	*	*	*	*	
Homalium vitiense	*					
Disemma cærulescens.—End.						
Melothria Grayana	*	*				
Tetragonia expansa	...	...	*	...	*	*
Sesuvium Portulacastrum	...	*	*	*	*	*
Hydrocotyle asiatica	*	*	*	*	*	*
Panax multijugum	*					
Meryta macrophylla	...	*				
Nauclea Forsteri	...	*				
Badusa corymbifera	*					
Bikkia grandiflora	*	*	...	*		
Oldenlandia fœtida	...	*				
„ paniculata	*	*	...	*	*	
Mussænda frondosa	*	*	...	*	*	
Randia coffæoides	*	*				
Tarenna sambucina	*	*				
100	84	71	42	55	48	21

Tonga Islands.	Polynesia.		Australasia.	Malaya.	Of wider range.	
	West.	East.			Old World.	New World.
100	84	71	42	55	48	21
Gardenia taitensis	*	*				
Guettarda speciosa	*	*	*	*	*	
Plectronia barbata	*	*				
,, odorata	*	*				
Morinda citrifolia	*	*	*	*	*	
,, Forsteri	*	*				
Psychotria amicorum	*	*				
,, insularum	*	*				
,, macrocalyx	*					
Geophila reniformis	*	*	...	*	*	*
Vernonia insularum	*					
Adenostemma viscosum	*	*	*	*	*	*
Dichrocephala latifolia	*	*	...	*	*	
Wedelia biflora	*	*	*	*	*	
,, strigulosa	*	*	...	*		
Scævola floribunda	*					
,, Kœnigii	*	*	*	*	*	
Wahlenbergia gracilis	*	...	*	*	*	
Mæsa nemoralis	*	*				
,, vitiensis	*					
Ardisia Listeri.—*Endemic*						
Bassia amicorum.—Endemic ...						
Mimusops Kauki	...	...	*	*	*	
Maba buxifolia	...	...	*	*	*	
,, elliptica	*	*				
Jasminum didymum	*	*	*	*		
,, simplicifolium	*	...	*			
Melodinus scandens	*					
Alyxia bracteolosa	*	*				
,, scandens	*	*				
,, stellata	*	*	...	*	*	
Cerbera Odollam	...	*	*	*	*	
Ochrosia parviflora	*	*	...	*		
Tabernæmontana orientalis ...	*	*	*	*		
Hoya australis	*	*	*			
Geniostoma crassifolium	...	...	...	*		
,, rupestre	*	*				
Fagræa Berteriana	*	*				
Cordia aspera	*	*				
,, subcordata	*	*	*	*	*	
Tournefortia argentea	*	*	*	*	*	
Ipomœa biloba	*	*	*	*	*	*
,, congesta	*	*	*	*		
,, denticulata	*	*	*	*	*	
,, peltata	*	*	*	*	*	
,, Turpethum	*	*	*	*	*	
,, martinicensis	*	...	*	*	*	*
Solanum amicorum.—Endemic.						
,, Uporo	*	*				
,, Forsteri	...	*				
,, oleraceum	*	*				
,, viride	...	*				
152	127	109	63	80	67	25

Tonga Islands.	Polynesia.		Austral-asia.	Malaya.	Of wider range.	
	West.	East.			Old World.	New World.
152	127	109	63	80	67	25
Cyrtandra Listeri.—Endemic...						
Hemigraphis reptans	*	...	...	*		
Eranthemum insularum	*					
Graptophyllum Siphonostena ...	*					
Premna taitensis	*	*	...	*		
Vitex trifolia	*	*	*	*	*	
Clerodendron amicorum	...	*				
,, inerme	*	*	*	*	*	
Leucas flaccida	*	*	*	*	*	
Teucrium inflatum	*	...	...	...	...	*
Pisonia inermis......................	*	*	*			
Cyathula prostrata	*	*	...	*	*	
Achyranthes aspera	*	*	*	*	*	*
Salsola Kali	...	...	*	*	*	*
Polygonum glabrum	*	*	...	...	*	*
Piper latifolium	*	*	...	*		
,, Macgillivrayi	*	*				
,, methysticum	*	*				
Peperomia leptostachya	...	*	*			
Myristica hypargyræa	...	*				
,, inutilis	...	*				
Hedycarya alternifolia.—End.						
,, dorstenioides	*	*				
Cassytha filiformis	*	*	*	*	*	*
Hernandia Mœrenhoutiana ...	...	*				
,, peltata	*	*	*	*	*	
Wikstrœmia rotundifolia.—End.						
Leucosmia acuminata	*	*				
,, Burnettiana	*	*				
Loranthus insularum	*	*				
Euphorbia Atoto	*	*	*	*	*	
,, obliqua	...	...	*			
,, pilulifera	*	*	*	*	*	*
,, Sparmannii	...	*	*			
Phyllanthus Gaudichaudii	...	*	...	*		
,, ramiflorus	*	*				
,, simplex	*	*	*	*	*	
Bischofia javanica.................	*	*	...	*	*	
,, leptopoda	...	*				
Codiæum variegatum	*	*	...	*		
Aleurites moluccana..............	*	*	*	*	*	
Acalypha grandis	*	*	...	*		
,, insulana	*	*				
Macaranga Harveyana............	*	*				
,, Seemanni	*					
Homalanthus pedicellatus	*	*				
Excœcaria Agallocha	*	...	*	*	*	
Celtis pacifica	...	*				
Trema amboinensis	*	*	*	*	*	
,, discolor	...	*				
Broussonetia papyrifera	*	*	*	*	*	
Ficus aspera	*	...	*			
204	164	149	82	102	84	31

Tonga Islands.	Polynesia.		Austral-asia.	Malaya.	Of wider range.	
	West.	East.			Old World.	New World.
204	164	149	82	102	84	31
Ficus prolixa	*	*				
,, scabra	*					
,, Storckii	*					
,, tinctoria	*	*				
Antiaris Bennettii	*					
Fleurya interrupta	*	*	*	*	*	
Laportea Harveyi	*					
Elatostemma sesquifolium	...	...	...	*	*	
Pipturus argenteus	*	*	*	*		
,, velutinus	*	*	...	*	*	
Casuarina equisetifolia	*	*	*	*	*	
Halophila ovata	*	*	*	*	*	
Dendrobium macranthum	*	...	...	*		
Spathoglottis pacifica	*	*				
Corymbis veratrifolia	*	*	*	*	*	
Canna indica	*	*	...	*	*	*
Crinum pedunculatum	*	...	*	*		
Tacca pinnatifida	*	*	*	*	*	
Cordyline terminalis	*	*	*	*	*	
Dianella ensifolia	*	*	*	*	*	
,, intermedia	*	*	*			
Commelina nudiflora	*	*	*	*	*	*
Pritchardia pacifica	*	*				
Cocos nucifera	*	*	*	*	*	*
Pandanus odoratissimus	*	*	*	*	*	
Raphidophora pertusa, *var.* vitiensis.	*	*				
Halodule australis	*	...	...	*	*	
Mariscus albescens	*	*	*	*	*	
,, cyperinus	*	*				
,, lævigatus	*	*				
Kyllinga monocephala	*	*	*	*	*	
Fimbristylis complanata	*	*	*	*	*	*
,, cymosa	*	*				
,, diphylla	*	*	*	*	*	*
Scleria depauperata	*	*				
,, lithosperma	*	*	*	*	*	*
Paspalum scrobiculatum	*	*	*	*	*	
Panicum ambiguum	*	*	...	*		
,, pilipes	*					
,, sanguinale	*	*	*	*	*	*
,, trigonum	*	...	...	*	*	
Oplismenus Burmanni	*	...	*	*	*	*
,, compositus	*	*	*	*	*	*
Cenchrus calyculatus	*	*				
Stenotaphrum americanum	*	*	*	*	*	*
Thuarea sarmentosa	*	*	*	*	*	
Coix Lacryma Jobi	*	*	*	*	*	
Erianthus maximus	*	*				
Andropogon aciculatus	*	*	*	*	*	
Eleusine indica	*	*	*	*	*	*
Centotheca lappacea	*	*	*	*	*	
255	214	189	110	136	114	42

Tonga Islands.	Polynesia.		Austral-asia.	Malaya.	Of wider range.	
	West.	East.			Old World.	New World.
255	214	189	110	136	114	42
Podocarpus elata	...	...	*			
Cycas circinalis	*	...	*	*	*	
Gleichenia dichotoma	*	*	*	*	*	*
Alsophila lunulata	*	*				
Davallia elegans	...	*	*	*	*	
,, solida	*	*	...	*	*	
Adiantum Capillus-veneris	*	*	*	*	*	*
,, diaphanum	*	*	*	*	*	
,, hispidulum	*	*	*	*	*	
Hypolepis tenuifolia	*	*	*	*		
Pteris comans	*	*	*	...	...	*
,, ensiformis	*	*	*	*	*	
,, longifolia	*	...	*	*	*	*
,, marginata	*	*	*	*	*	
,, quadriaurita	*	*	*	*	*	*
Blechnum orientale	*	*	*	...	*	
Asplenium falcatum	*	*	*	*	*	
,, obtusatum	...	*	*	...	...	*
Aspidium aristatum	*	*	*	*	*	
Nephrodium dissectum	*	*	*	...	*	
,, Henkæanum	*	*	...	*	*	
,, Harveyi	*	*				
,, invisum	*	*				
,, latifolium	*	*				
,, molle	*	*	*	*	*	*
Nephrolepis acuta	*	*	*	*	*	*
,, exaltata	*	*	*	*	*	*
Polypodium adnascens	*	...	...	*	*	
,, nigrescens	*	*	*	*	*	
,, Phymatodes	*	*	*	*	*	
Acrostichum aureum	*	*	*	*	*	*
Schizæa dichotoma	*	*	*	*	*	*
Ophioglossum pendulum	*	*	*	*	*	
Lycopodium cernuum	*	*	*	*	*	*
Psilotum triquetrum	*	*	*	*	*	*
TOTALS 290	246	220	138	162	141	55

6. *Summary of the preceding Table.*

This table has been drawn up since the paper was read, and supplements, and in some particulars repeats, the "Introductory Note."

The most striking features are, first, the large number of species of very wide range, and, secondly, the large number of purely Polynesian species; and the proportion of the latter might have been made to appear even larger by eliminating a number of other species of wide range which very probably owe their presence to human agency, direct or indirect. Out of a total of 290 species, 105, or more than a third, are confined to Polynesia; and on examination it will be found that a large number of these species are peculiar to the Fiji, Navigator, and Tonga groups of islands, fewer extending eastward to the Society Islands, or westward to the New Hebrides. Considering the area and elevation of the islands and the extent of cultivation in bygone times, the number of indigenous vascular plants still existing is considerable; and, as in most insular floras, the number of natural orders and genera represented is large in proportion to the number of species. Out of the 202 natural orders recognized in Bentham and Hooker's 'Genera Plantarum,' 79 are represented by apparently indigenous species in the Tonga Islands; and the 290 species comprise no fewer than 202 genera. From calculations I have published elsewhere*, based upon the numbers of the 'Genera Plantarum,' the proportions for the whole world are: 37·50 genera to an order, and 12·65 species to a genus. In the Tonga Islands the proportions are: 2·55 genera to an order, and 1·43 species to a genus. The proportion of species to genera is about the same as in the remote insular flora of St. Helena, calculated from the probably indigenous species. It may be interesting to repeat here the figures for some distant dissimilar and larger areas:—

	Average number of Genera to an Order.	Average number of Species to a Genus.
India	13·0	6·0
Mexico	11·0	6·4
America, north of Mexico	9·6	6·2
Australia	8·7	6·4

In further illustration of the general distribution of natural orders, it may be added that 174 are represented in British India, 163 in Mexico and Central America, and 144 in Australia.

The object of giving the foregoing figures is to demonstrate the composite character of the Polynesian flora; to demonstrate that natural orders have, with very few exceptions, a wide distribution; to demonstrate that there must have been general migrations; to demonstrate that the vegetation of the world must be the evolution of the same elements throughout, and not of different elements in different parts of the world. In illustration of this I will proceed to further details of the composition and character of the Polynesian flora. I have already stated that the most striking fact brought out by the preceding Table is the large proportion of species—upwards of a third—peculiar to Polynesia. Another fact, which does not come out, either in the Enumeration or in the Table, is the complete absence of peculiar generic types in the Tonga Islands; and even if we include the Fiji and Navigator groups, the number is exceedingly small. Seemann (Fl.Vit., Introd. p. xvii) could only adduce 16, and some of these were doubtful. Subsequent discoveries, especially in Malaya, have reduced that number, whilst the more complete exploration of Fiji has not resulted in the discovery, I believe, of a single new genus. And if we include the flora of the Gilbert, Phœnix, Ellice and Union groups, the results would be practically the same. In Eastern Polynesia there is a larger proportion of endemic genera, but nothing approaching a natural order. Even in so highly specialized a flora as the Hawaiian, only about 40 genera out of 250 are restricted to those islands, and they are perhaps more remarkable for habit than for floral structure. In the Society Islands there are very few endemic genera, or, going further, peculiarly Polynesian genera, and one of the most singular of these, *Lepinia*, as pointed out at p. 165, has recently been rediscovered so far westward as the Solomon Islands *. Returning to the peculiarly Polynesian species of the Tongan flora, we find that 55 have both an eastward and a westward extension; 28 a westward extension only; 12 an eastward extension only; and 10, so far as at present known, are endemic. These are:—*Canarium Harveyi*, *Vavæa amicorum*, *Memecylon Harveyi*, *Disemma cærulescens*, *Ardisia Listeri*, *Bassia amicorum*, *Solanum amicorum*, *Cyrtandra Listeri*, *Hedycarya alternifolia*, and *Wikstrœmia rotundifolia*. But some of these may prove either to have a wider range or not to be specifically different when intermediate forms may have been found. On the other hand, it is not probable that unknown species remain to be discovered in these islands.

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* 'Biologia Centrali-Americana, Botany,' vol. i. Introduction, p. xxiii.

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* Drake del Castello, 'Flore de la Polynésie Française,' Introduction, p. xix, tabulates the distribution of 588 species, belonging to 79 natural orders. His results are: 161 peculiar to French Polynesia (Society, Marquesas, Pomotou, Gambier, and Wallis Islands); 123 extending to Oceania; 297 to Indo-Malaya; and 7 to other regions. These figures are to some extent inaccurate, inasmuch as the full distribution is not always given.

Passing to the distribution of the species which extend beyond Polynesia, we have 138 in the Australasian column, 162 in the Malayan, 141 having a distribution beyond Australasia and Malaya in the Old World, and 55 in the New World. Adding the species having an Australasian or Malayan extension to the purely Polynesian species might, without due consideration, lead us to suppose that the Australasian affinities of the Tonga flora were nearly as strong as the Malayan; but such a conception is dissipated by the figures in the two last columns relating to species of wider distribution. Furthermore, it is manifest from the very small number of species which extend to some part of Australasia, but are not found elsewhere beyond the limits of Polynesia, that the Australian connections are exceedingly slight. The following are the only species coming under this category:—*Melicytus ramiflorus*, *Ratonia stipitata*, *Metrosideros polymorpha*, *Jasminum simplicifolium*, *Hoya australis*, *Ipomœa congesta*, *Pisonia inermis*, *Peperomia leptostachya*, *Euphorbia Sparmannii*, *Ficus aspera*, *Podocarpus elata*, and *Pteris comans*.

After examining all the facts, and especially the distribution of the genera, and the nearest affinities of the apparently endemic Polynesian species, there is no doubt that the combined Fijian, Samoan, and Tongan flora is eminently Malayan in character.

I would only repeat, in conclusion, that the distribution may not be quite complete in all cases; hence the figures may be subject to slight modifications, but the main issues would not be thereby affected.

7. *Descriptions of New Plants from the Tonga and Solomon Islands.*

Dysoxylum megalanthum, *Hemsl.* (Plate IX.)

Species pro magnitudine florum insignis, calyce irregulariter 3–4-lobato.

Arbor usque ad 30 pedalis alta (fide *Cominsii*). *Folia* (perfecta non visa) fere glabra vel cito glabrescentia, petiolata, abrupte pinnata, rhachi terete gracili, 7 poll. longa; foliola 8, opposita, breviter petiolulata, papyracea, oblonga, 2–4 poll. longa, inferiora breviora, integra, obtusa vel obtuse acuminata, basi inæqualia, venis primariis lateralibus utrinque circiter 12 sat conspicuis. *Flores* albi (fide *Cominsii*) polygami? circiter 10 lineas longi et 12 lineas diametro, racemosi (racemis terminalibus fide *Cominsii*),

pedicellis crassiusculis 6–12 lineas longis; calyx cupularis, crasse coriaceus, irregulariter 2–4-lobatus, lobis rotundatis vel minoribus interdum subacutis; petala 4, oblonga, obtusa, extus sericeo-tomentosa, quam calyx dimidio longiora; tubus stamineus cylindricus, 8–10-dentatus, antheris 8–10 inclusis vel brevissime exsertis petala subæquantibus; discus cylindricus, ovarium inclusus; ovarium dense tomentosum, 4-loculare, loculis uniovulatis, stylo sursum glabro, stigmate capitato. *Fructus* ignotus.

Solomon Islands: without locality, *Rev. R. B. Comins*, 241.

Crossostylis Cominsii, *Hemsl.* (Plate X.)

Folia fere membranacea. Flores parvi, staminodiis nullis, petalis integris.

Arbor usque ad 18 ped. alta (ex *Comins*), ramulis floriferis glabris. *Folia* tenuia, glaberrima, longiuscule petiolata, lanceolata vel oblanceolata, cum petiolo 6–7 poll. longa et 2½–3 poll. lata, obtusa, basi cuneata, venis primariis lateralibus utrinque circiter 8 prope marginem inter se anastomosantibus subtus sat conspicuis. *Flores* 4–5 lineas diametro, pedicellati, in axillis foliorum fasciculati, pedicellis circiter semipollicaribus; sepala 5–6, crassa, tertia parte connata, intus carinata, hirsutula; petala totidem, spathulata, integra, quam sepala paullo breviora, cito decidua; stamina circiter 30, disco cupuliformi inserta; ovarium sæpe 10-loculare, loculis 2-ovulatis, vertice facile calyptratim dehiscens. *Fructus* ignotus.

Santa Cruz, New Hebrides, *Rev. R. B. Comins*, 279.

Eugenia salomonensis, *Hemsl.*

Species ornata, floribus rubris speciosissimis laxissime paniculatis, paniculis longissime pedunculatis pendulis.

Arbor magna (*Comins*), novellis omnino glabris, ramulis gracilibus. *Folia* breviter petiolata, subcoriacea, minutissime pellucido-punctata, oblongo-oblanceolata, 4½–7 poll. longa, subite acuminata, vix acuta, basi rotundata, venis primariis lateralibus numerosis 1½ lineas ab margine inter se anastomosantibus. *Paniculæ* terminales (*Comins*) cum pedunculo gracillimo sesquipedales, ramulis secundariis oppositis divaricatis paribus distantibus, ramulis ultimis 2–5-floris. *Flores* umbellati, subsessiles, cum staminibus circiter sesquipollicares; calycis campanulati lobi rotundati, circiter 1½ lineas longi et lati; petala fere orbicularia, circiter 3 lineas diametro, cito decidua; stamina numerosissima, filamentis fere sesquipollicaribus capillaribus ut videtur sanguineis.

FLORIDA ISLAND, Solomon group, *Rev. R. B. Comins*, 232.

A handsome species characterized by the very long, loose, pendulous inflorescence.

Cyrtandra Listeri, *Hemsl.*

Species *C. Tempesti*, Horne, valde affinis, differt imprimis foliis minoribus late ovatis basi rotundatis crenatis.

Frutex nanus (fide *Lister*), ramulis floriferis crassis subcarnosis primum ferrugineo-puberulis. *Folia* opposita, æqualia, breviter petiolata, crassiuscula, late ovata, interdum fere rotundato-ovata, cum petiolo 3–5 poll. longa et 2–3 poll. lata, obtusa, crenulata, utrinque, præcipue subtus, puberula, subtus pallidiora, venis primariis lateralibus utrinque circiter 6 crassiusculis curvatis. *Cymæ* axillares, sesquipollicares, paucifloræ, pedicellis ferrugineo-puberulis 5–6 lineas longis. *Flores* mediocres; sepala 5, sublibera, decidua, breviter inæqualia, ovali-oblonga, circiter 4 lineas longa, subobtusa, corollæ tubum fere æquantia, extus ferrugineo-pubescentia; corolla glabra, vix 9 lineas longa, distincte bilabiata, labio inferiore longiore, lobis latis rotundatis ut videtur sinuatis, tubo lato leviter curvato antice ventricoso; filamenta crassa, geniculata; antheræ magnæ, approximatæ vel conniventes, primum in corollæ ventrum positæ; discus magnus, cupularis; ovarium ovoideum, glabrum, leviter verrucosum, stylo brevi crasso, stigmate maximo bilobato.

Ardisia Listeri, *Stapf.*

Affinis *Ardisiæ grandi*, Seem., sed omnibus partibus minor staminibus in tubum brevem corollæ basi tantum adnatum coalitis.

Frutex 4–5 ped. altus, glaberrimus, ramulis crassis pallidis apicem versus cicatricibus rotundis crebris notatis. *Folia* oblongo- vel obverse-lanceolata, 4–6 poll. longa, 1¼–1¾ poll. lata, in petiolum ½–¾ poll. longum attenuata, obtusiuscula, nervis lateralibus tenuibus utrinque 12–14. *Paniculæ* plures terminales 1 poll. longæ, ¾ poll. latæ, pedunculo gracili 1–1½ poll. longo suffultæ pedicellis tenuibus. *Calyx* quinquelobus, ½–¾ lin. longus, lobis rotundatis minute ciliatis. *Corolla* 1¼ lin. longa, ad ⅔ quinquepartita, lobis ovatis obtusis. *Filamenta* in tubum basi cum corolla connatum in ore antheras cordato-ovatas acutiusculas gerentem coalita. *Ovarium* ovoideum in stylum æquilongum abiens, stigmate quinqueangulari, ovulis 3 placentæ immersis.—*O. Stapf.*

EUA, Tonga, in rupibus calcareis summi jugi insulæ, *Mr. J. J. Lister*, 1889.

Graptophyllum Siphonostena, *F. Muell.*, *Fragm.* vi. 87.

Frutex glaberrimus ramis mox albicantibus. *Folia* oblonga vel elliptica vel ovato-oblonga, 1–3 poll. longa, ½–1½ poll. lata, basi in petiolum 3–6 lin. longum attenuata, obtusiuscula vel subacuminata, membranacea, nervis lateralibus utrinque 4–7, tenuibus. *Cymæ* axillares et terminales sæpe ad flores 2 vel 1 redactæ, bracteis minutis, pedicellis gracilibus 2–3 lin. longis. *Calyx* 1–1½ lin. longus, fere ad basin 5-partitus, segmentis triangularibus vel triangulari-subulatis. *Corollæ* tubus 1 poll. longus, leviter incurvus, superne sensim ampliatus, lobi subæquales, ovati, 5 lin. longi, apice pilosuli. *Filamenta* e fauce breviter exserta. *Staminodia* minuta. *Capsula* clavata.—*O. Stapf.*

EUA, Tonga, in rupibus calcareis, *Mr. J. J. Lister*, 1889; VAVAU and LIFUKA, *W. H. Harvey*, 1885; OVALAU, Fiji group, *Seemann*, 1854.

There are only three species known from Australia, and a fourth, which is cultivated all over India and the Malay Archipelago, but has never been found in a wild state. As Sir F. von Mueller gave the name to Seemann's specimen without a proper description, I thought it worth while to describe the plant more accurately. It is nearest allied to *G. Earlii*, F. Muell., which, however, is a tree with smaller leaves and a shorter and wider corolla-tube and more robust capsules.

Ruellia Guppyi, *Hemsl.*

Species ex affinitate *R. aruensis*, S. Moore, sed fere glabra foliis longe petiolatis, bracteolis calycis dentibusque brevioribus, corollæ tubo subite in limbum patentissimum expanso.

Herba vel suffrutex ramosus, sesquipedalis (*Guppy*), cito glabrescens. *Folia* petiolata, fere membranacea, primum minute strigillosa, anguste oblongo-lanceolata, cum petiolo usque ad 7 poll. longa et 1½ poll. lata, obtusa vel subacuta, basi cuneata, sæpe inæqualia, obscurissime late crenata, venis primariis lateralibus utrinque circiter 8–9 prope marginem inter se anastomosantibus; petiolus usque ad 2 poll. longus. *Flores* flavi, axillares (solitarii?) pedunculo brevi, bracteis bracteolisque parvis subulatis; calycis dentes subulati, semipollicares; corolla leviter obliqua, fere hypocrateriformis, tubo circiter 3 poll. longo angusto vix curvato, limbo subæqualiter 5-lobo, fere 2 poll. diametro, lobis latis. *Stamina* 4, inclusa. *Ovarium* multiovulatum. *Capsula* non visa.

TREASURY ISLAND, Solomon group, *Dr. H. B. Guppy*, 186; ULAWA, in the same group, *Rev. R. B. Comins*, 264. These two localities are almost at the two extremities of this chain of islands.

Hedycarya ? alternifolia, *Hemsl.*

Species insignis, si hujus generis, foliis alternis.

Frutex vel arbor undique glabra. *Ramuli* ultimi pallidi, verruculosi. *Folia* alterna, coriacea, in siccis nigrescentia, breviter petiolata, rotundato-ovata vel late elliptica, cum petiolo usque ad 5 poll. longa et 3 poll. lata, obtusa, remote obscureque denticulata, venis primariis lateralibus utrinque 4–5. *Flores* ♂ vix sesquilineam diametro, racemosi, racemis parvis axillaribus; perianthium depressum, obscurissime lobatum, margine ciliolatum; stamina numerosissima antheris subsessilibus.

TONGA ISLANDS, *Mr. J. J. Lister.*

Antiaris turbinifera, *Hemsl.*

Inter species Polynesiæ magnitudine fructus insignis.

Arbor 80–100-pedalis (fide *Comins*). *Folia* petiolata, subcoriacea, oblongo-obovata, sine petiolo usque ad 6 poll. longa, integra, obtusissima, basi cuneata, supra nitida, subtus pallidiora, venis primariis lateralibus utrinque 8–9 inter se prope marginem anastomosantibus; petiolus sesquipollicaris. *Receptaculum* florum ♂ breviter pedunculatum, circiter 9 lineas diametro, ut videtur cupulatum, carnosum, extus verrucosum, multiflorum, involucro brevissime 5-lobato, lobis late rotundatis, margine incrassatis. *Perianthium* tenuissimum, perfectum non visum; filamenta brevissima. *Fructus* ellipsoideus, siccus 2½ poll. longus et 2 poll. diametro.

PAURA, ULAWA, etc., Solomon Islands, *Rev. R. B. Comins.*

The Rev. R. B. Comins, to whom we are indebted for this and many other curious plants from Polynesia, sends a specimen of a humming-top made by natives of the Solomon Islands from the fruit of *Antiaris turbinifera*. After the fleshy part of the fruit has been removed or has decayed, there remains an excessively hard endocarp of ivory-like density. The peduncle disarticulates

from the base of the fruit and the continuation into the fruit decays and falls away, leaving a circular aperture, about a third of an inch in diameter, and as clearly defined as though it had been cut. To form the humming-top, the natives bore holes at right angles to this and insert a peg, the exserted part being about as long as the diameter of the fruit. It is spun by a double string wound round the peg in the same direction, the free ends of the string being pulled in opposite directions to impart the impetus to the top. It is probable that this natural hole in the fruit serves as a point of egress for the radicle in germination.

PANDANACEÆ.

SARARANGA, *Hemsl.*, gen. nov.

Flores, ut videtur, dioici, ♂ ignoti. Florum ♀ spadix paniculatus, ramosissimus, amplissimus, ramuli ultimi incrassati, sphæroidei, receptacula florifera carnosa sinuosa involucrata formantes, involucro brevi sinuoso. Flores ♀ (perjuveniles tantum visi) omnino immersi, flexuoso-biseriati, et mamillis (stigmatosis?) superficialibus biseriatis conjuncti; staminodia nulla; ovarium 1-loculare, 1-ovulatum. Fructus ignotus.

Sararanga sinuosa, *Hemsl.* (Plate XI.)

Arbor 50–60-pedalis, radicibus aereis nullis (ex *Guppy*). *Folia* coriacea, lineari-lanceolata, basi 4 poll. lata (*Guppy*), apicem versus tantum aculeolata. *Spatha* ignota. *Spadix* albus, 4–5 ped. longus (*Guppy*), receptacula (*i. e.* spadicis ramuli ultimi) circiter $\frac{1}{3}$ poll. diametro, sed forsan fructifera accrescentia.

FAURO ISLAND, Solomon group, at elevations of 1600 to 1900 feet, *Dr. H. B. Guppy*; JOBIE ISLAND, North-east New Guinea, *Dr. O. Beccari*.

I am indebted to my colleague Dr. Otto Stapf for the drawings of the microscopical dissections of the inflorescence.

DESCRIPTION OF THE PLATES.

PLATE IX.

Portion of compound leaf and raceme of flowers of *Dysoxylum megalanthum*, Hemsl., natural size.

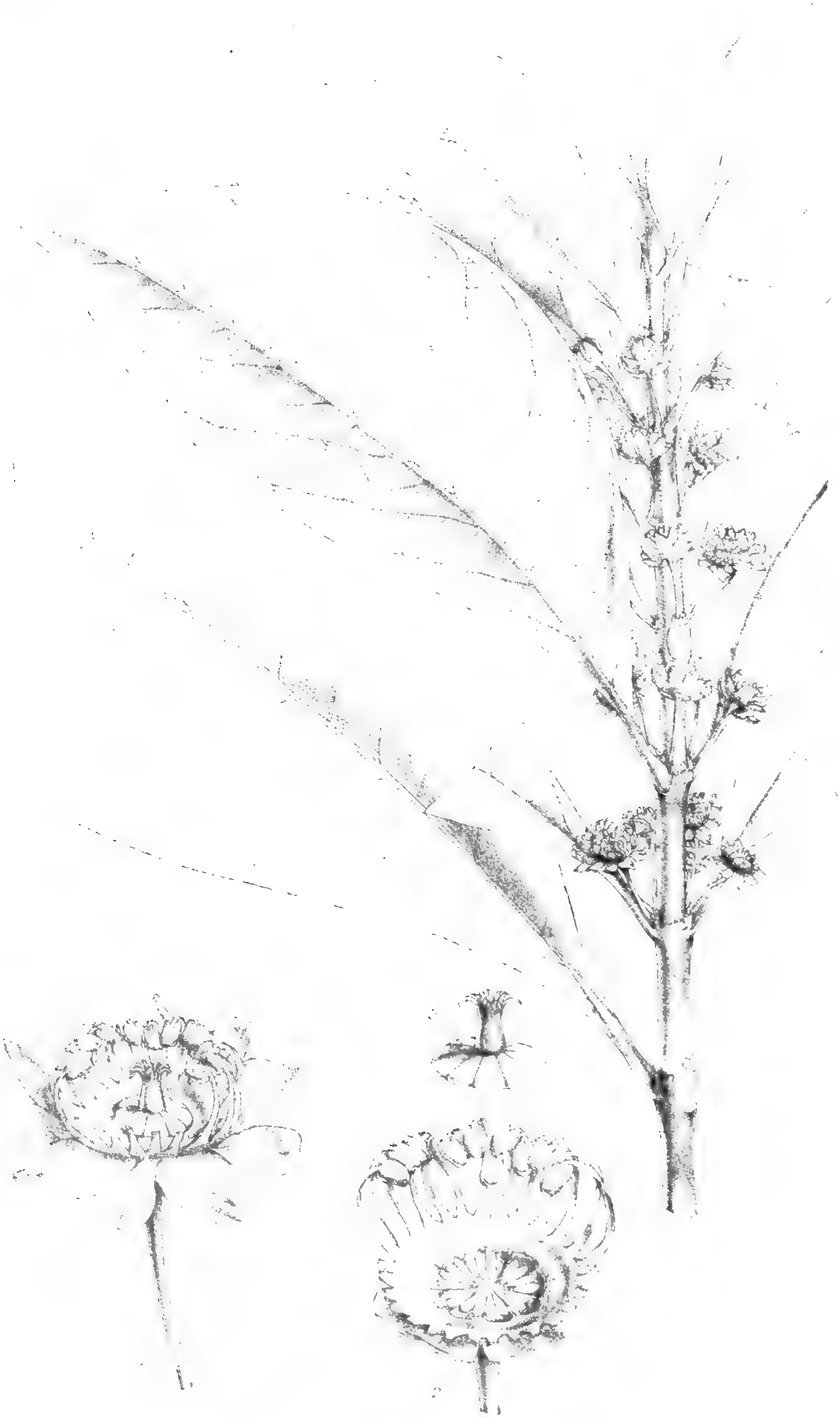
Fig. 1. Longitudinal section of a flower, showing the hairy ovary half immersed in the cylindrical disk; fig. 2, cross section of ovary; fig. 3, vertical section of the same. All enlarged.

C. Fitch lith.

J.N. Fitch imp.

DYSOXYLUM MEGALANTHUM, *Hemsl.*

Hemsl. LINN. SOC. JOURN. BOT. VOL. [illegible] PL. II



C. Fitch lith.

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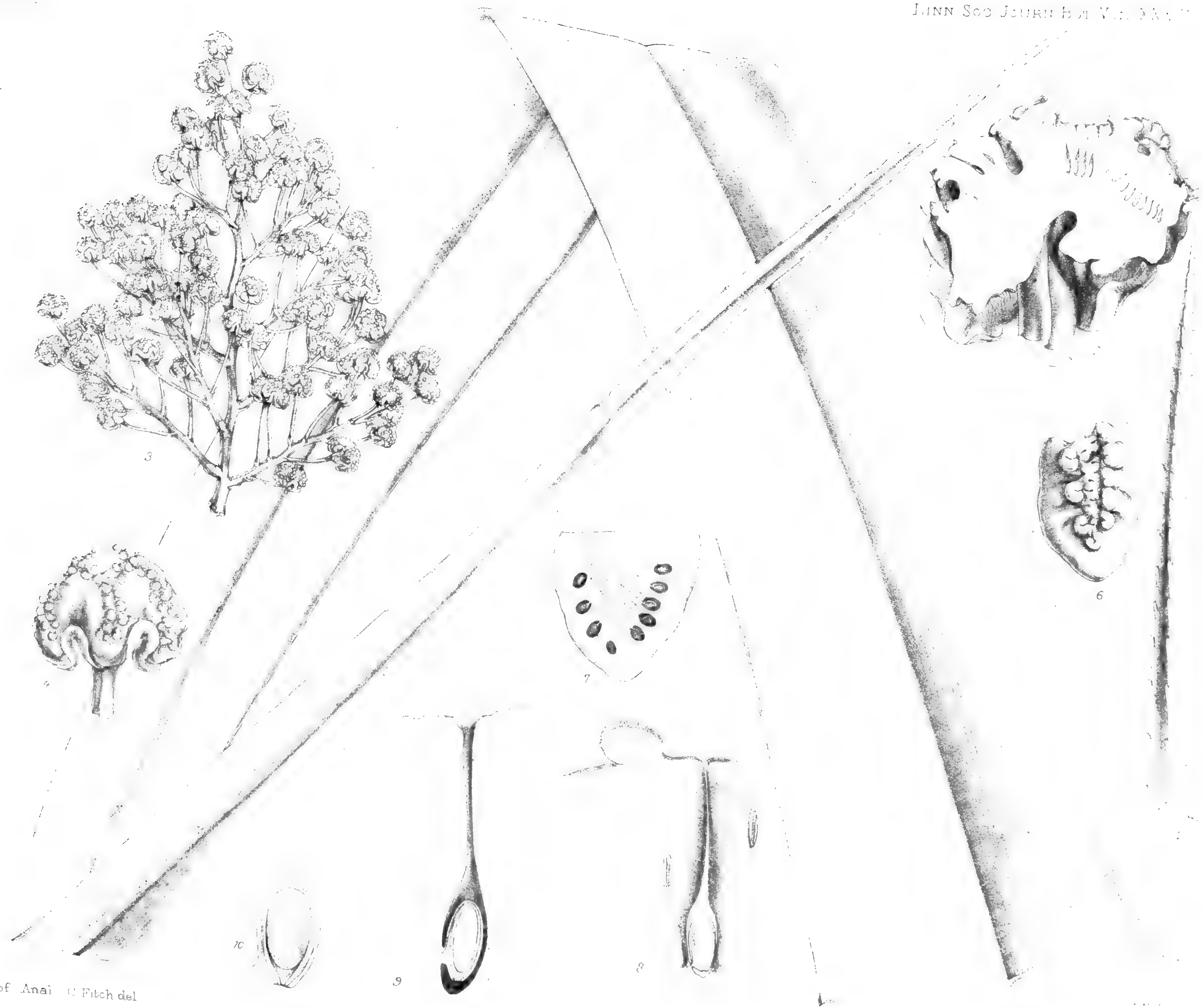

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SARARANGA SINUOSA, *Hemsl*

Plate X.

Flowering branch of *Crossostylis Cominsii*, Hemsl., natural size.

Fig. 1. A flower; fig. 2, the same, with the sepals and petals and some of the stamens removed, showing the ovary in cross section; fig. 3, the top of the ovary and stylar column. All enlarged.

Plate XI.

Sararanga sinuosa, Hemsl.

Fig. 1. Upper portion of a leaf, which Dr. Guppy describes as 4 inches broad in the lower part: natural size.
2. Tip of the same, enlarged.
3. Small portion of female inflorescence, which is 4 to 5 feet long: natural size.
4. One of the ultimate branchlets of the inflorescence, or receptacles in which the female flowers are embedded, with biseriate mammæ and sinuous involucre, × 3.
5. The same in longitudinal section, × 8, showing some of the ovaries.
6. A portion of the surface of one of the lobes, × 8.
7. A cross section of the same, some distance below the surface, showing the biseriate ovaries corresponding to the superficial mammæ, about × 8.
8. A vertical section, × 20, showing ovary and stigmatic tube.
9. Another section, still further enlarged.
10. Ovule, about × 40.

The Origin of Plant-Structures by Self-Adaptation to the Environment, exemplified by Desert or Xerophilous Plants. By the Rev. George Henslow, M.A., F.L.S., &c.

[Read 16th November, 1893.]

(Plate XII.)

Contents.

I. Introductory Observations on the Characteristic Features of Plants of Deserts and Arid Countries.
II. General Morphological Characters.
III. Spinescent Characters.
IV. Foliage of Desert Plants.
V. Succulent Plants.
VI. Protection of Buds.
VII. Roots.
VIII. Histological Peculiarities of Desert Plants.
IX. Assimilative Tissues.
X. Ligneous Tissues.
XI. Water-storage Tissues.
XII. Secretions.
XIII. General Summary of Observations on Desert Plants.
XIV. Self-fertilization of the Flowers of Desert Plants.

I. *Introductory Observations on the Characteristic Features of Plants of Deserts and Arid Countries.*

The general *facies* of the flora of a country with a relatively dry soil and atmosphere is very observable; and when it is found to be the same in widely separated countries—as in the desert regions of North Africa, in the arid districts of India and Thibet, of Afghanistan, in parts of Australia, in S. Africa, in Brazil*, &c.,—

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* For an interesting description of the plants growing in a very dry region of Brazil, but probably of less intensity than that of the African deserts, the reader is referred to a paper by M. Ed. Warming entitled, "Lagoa Santa (Brésil), Étude de Géographie Botanique," Rev. gén. de Bot. 1893, p. 145. Many peculiarities mentioned by that author correspond more or less exactly with those I have described in this paper.

Grisebach also compares the S. African region (Kalahari) with the Soudan:—"Les autres formes végétales sont les mêmes qu'on retrouve dans d'autres steppes et déserts, ou bien elles signalent l'intime affinité du Kalahari et du Soudan. À la première catégorie appartiennent les plantes grasses (*Euphorbia, Mesembryanthemum*), les végétaux bulbeux qui ouvrent rapidement leurs fleurs après les orages d'été (ex. *Amaryllis*); parmi les arbustes, les formes de Spartium (ex. *Lebeckia*), de l'Oléandre (par l'entremise d'une Rubiacée, le *Vangueria*), et du Myrte (par une Ébénacée, l'*Euclea*); enfin, les arbustes à feuilles velues, particulièrement fréquents dans la savane (*Tarchonanthus*)." (Vég. du Globe, vol. ii. pp. 255, 256.)

so that these several countries afford either the same or "representative plants," one infers (but of course at first merely on *à priori* grounds) that most probably similar causes have produced these similar results. A closer inspection shows that the similarities in the vegetative system of such plants, which often have no affinity between them whatever, can be carried down into the minutest details of histological structure; and that a large proportion of such structures at least are always serviceable to the plants in resisting the deteriorating effects of an insufficient supply of water, as well as of an excess of radiation and other hindrances to such vigorous growth as is maintained in moister climes.

We thus begin to suspect, indeed very strongly, that the various peculiarities (such, *e. g.*, as the densely hirsute clothing and the consolidation of the mechanical tissues) are the direct results of the dry climatal conditions surrounding the plants; and that the unfavourable environment actually brings about the production of just those kinds of structure which are best able to resist the injurious effects of the climate, and so enables the plant to survive under them. Such, at least, is the result of my own observations on the plants of the Egyptian deserts.

The distribution of similar forms of plants under similar conditions illustrates another fact. We speak of "chalk-loving," "sand-loving," and other kinds of plants frequenting special environments; but these phrases seem to be, to a great extent, misnomers. Plants by no means all or always "love" the soils alluded to, in which they are often found. Many flourish quite as well, if not better, in a totally different soil. Having, however, been located in them for many generations, they have become so adapted to the peculiar conditions of the soil and climate, *by assuming such structures as are the best under the circumstances*, that they now succeed in them; but at the same time many are always tacitly protesting, so to say, against their environment; for they at once show how much more vigorous they can become when they are grown in a different and more congenial soil *.

Similarly we might just as well speak of desert-loving plants, corresponding to the term "xerophile;" but we know what an intense struggle for existence they have to maintain. Nevertheless they have become so inured to their difficulties, that when seeds of desert plants are sown in ordinary garden-soil many fail to grow at all[*]; just as, while some water-plants grow more vigorously on land, others cannot live if exposed to the air. Or, again, with regard to many maritime plants, they will grow quite as well, if not better, away from the sea, either by altering their structure as Samphire does, by developing flat and thin leaves, or else they may retain their usual features, this being due to heredity. Thus *Salsola Kali*, the Prickly Glasswort of our sandy sea-shores, has become one of the worst weeds ever introduced into American wheat-fields. One year's damage in Dakota alone is estimated at 2,000,000 dollars. It is described as taking complete possession of the soil, while its spiny nature makes it objectionable to horses and other animals (Farmer's Bulletin, No. 10, 1893). In this case the plant has not lost its spines by growing in a richer soil, and illustrates the fact that hereditary influences often, if not always, *tend*, more or less, to resist the effects of a changed environment. And just as new adaptations can easily become fixed in some cases, but with great difficulty in others, as in cultivating wild plants; so, conversely, while some features are instantly lost, others are as rigidly retained, though it may be in a modified form. What, however, may be called the general "plasticity" of plants is now so well recognized, that it affords us a perfectly adequate means in accounting for the self-adaptation of plants, although it is far from being necessarily applicable in every feature.

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* See Battandier's observations, Bull. Soc. Bot. de Fr. 1887, p. 189

I will now give some special characteristic features of desert plants, and then compare them with others growing in arid districts to show the more or less great similarity which prevails.

II. *General Morphological Characters*[†].

On first entering the desert near Cairo, where plants are to be found,—namely, along the lines of watercourses, which are dry all the year round excepting in February and March, while no plants occur on the higher ground at all,—the general appearance is of low bushes or isolated tufts of a nearly uniform grey colour. The plants are never crowded or cover the ground like an English roadside. In other words, they do not struggle for an existence with one another, but only with their inhospitable inorganic environment *. The grey colour is mainly due to intense hairiness, which subdues the green hue of chlorophyll. A few plants only, comparatively speaking, have no hair, and are consequently greener, as the species of *Zygophyllum*, which are fleshy-leaved plants; but a coating of wax is of frequent occurrence, and this aids in giving a glaucous hue.

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[*] According to Dr. E. Sickenberger in Cairo and to my own experiments at home.

[†] The best work I am acquainted with on the structure of desert plants is one by Dr. G. Volkens, entitled "Die Flora der aegyptisch-arabischen Wüste auf Grundlage anatomisch-physiologischer Forschungen dargestellt," and the epitome "Zur Flora der aegyptisch-arabischen Wüste, eine vorläufige Skizze." He gives eighteen plates (4to) illustrative of the anatomy of a well-selected series of types. I have fortunately been able to collect a large number of the same plants myself in the deserts around Cairo; and for nearly all the

The hair and the wax, as well as the fleshy character of the leaves, are adaptations to arrest the loss of water by transpiration during the summer.

III. *Spinescent Characters.*

The next obvious feature is the stunted character of the bushes, three feet being about the maximum height (*Zilla myagroides*), with gnarled stems at the base. This is often coupled with a spinescent character, either in the branches (as *Zilla*), foliage (as *Echinops*), or stipules (*Fagonia*) and bracts (*Centaurea*). These features are, we may say undoubtedly, in the

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rest I am greatly indebted to the kindness of Prof. E. Sickenberger, of the School of Medicine, Cairo; so that I have been able to examine anatomically nearly the whole series described by Dr. Volkens, and have thus been able to supplement his observations in some degree in points he has not recorded. I would also refer the reader to the writings of M. P. Maury, Assoc. Franç. pour l'Avancement des Sci., Congrès de Toulouse, 1887; also Morot's Journ. de Bot. ii. 1888, Rev. Bibl. p. 101.

* Similarly of the desert regions of Beluchistan, Dr. Aitchison says:—"The barren character of the country and the want of indigenous trees is due to the extreme dryness of the soil and aridity of the atmosphere. . . . The struggle of plant-life for existence is great. The plants which are seen to exist through it all are either annuals or those possessing great root-stocks, tubers, tuberous roots, rhizomes, bulbs, or other such structural developments as assist them to baffle and survive through the extremes of temperatures."—"A Summary of the Botanical Features of the Country traversed by the Afghan Delimitation Commission during 1884–5," Trans. and Proc. Bot. Soc. Edinb. 1889 (read April 11th, 1889), p. 42.

main due to a want of water *, which always prevents the formation of cellular tissue; while this deficiency of parenchyma is associated with a hardening of the fibro-vascular mechanical elements. The converse conditions are sometimes witnessed, *e. g.* in a plant of *Zilla myagroides*, which was the only species raised from seed out of many sown in the Botanic Garden of Cairo by Dr. E. Sickenberger. It not only bore well-developed leaves, but the spines, though formed through the forces of heredity, were very slender and subflaccid instead of being intensely rigid.

As an interesting illustration of a highly spinescent plant belonging to the Cucurbitaceæ, an order in which it would be least expected, is the Narras plant of Caffraria (*Acanthosicyos horrida*). It grows on the sandy downs on the sea-coast. It has no leaves, but double spines studded all over the branches, forming impenetrable bushes which spread widely and attain the height of a man. It is curious that although the seeds germinate readily, all attempts to cultivate it in Europe have failed; just as Dr. Sickenberger and I failed with the numerous desert plants of Egypt, for, as stated, he was only successful with *Zilla myagroides.* Another remarkably spinescent plant is *Aciphylla squarrosa* of the order Umbelliferæ, described by Sir J. D. Hooker in his 'New Zealand Flora,' vol. i. p. 87.

The hardening of the mechanical tissues generally, which so often results in special spiny processes, is brought about by drought and other conditions of the environment, and is one of the best means for resisting the intense heat of the desert.

M. de Candolle † called attention to this fact. He says:—"Very hard wood resists heat because it encloses but little aqueous juices, so there is but little to evaporate." Similarly he remarks upon the great value of cork for resisting both extreme cold as well as extreme dry heat; as there will be a greater number of cells in the layers of cork filled with air, thus making bad conductors between the external air and the cambium layer and alburnum. Thus old trees resist cold better than young ones. On the other hand, endogenous trees having no bark only grow in warm climates. In some, as the Date, the bases of the leaves, especially if they decompose into a hairy covering, may supply the place of it.

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* So Mr. Belt, in 'The Naturalist in Nicaragua,' says (p. 46):—"This spiny character of vegetation seems to be characteristic of dry rocky places and tracts of country liable to great drought."

Similarly Grisebach, describing the flora of Kalahari, South Africa, and alluding to spinescent species of *Acacia*, says:—"Tous ils portent des épines qui, chez *A. horrida*, ont 5 à 8 centimètres de longueur. La division limitée du feuillage et l'exiguïté des surfaces sont autant de traits en rapport avec le développement des organes piquants et de la sécheresse du sol" (La Végét. du Globe, ii. p. 252). He also alludes to similar features of the Tibetan flora (i. p. 614).

† "Essai élémentaire de Géographie Botanique," Dict. des Sci. Nat. vol. xviii.

The evidence in support of the assertion that spines are the direct outcome of the environment also rests upon the well-known fact that there are many instances of plants losing their spines altogether when grown under other circumstances. This variableness in the spinescent character of plants is no new observation. Thus, G. G. Küchelbecker, in a 'Dissertatio botanico-physica de spinis plantarum' (A.D. 1756), wrote as follows:—"Sunt autem quaedam plantae quae eundem semper et vbique seruant in extensione superficiei habitum, cum contra ea aliae, pro varia soli et culturae indole, formam hanc alias sibi propriam deponant, vel tamen maximam sui partem mutent, ita vt, quae glabrae antea erant, nunc inaequalitatem magis minusue eminentem induant, atque suum plane deposuisse videantur habitum superficiei pristinum" (pp. 9, 10). He then refers to Linnæus's Philos. Bot. p. 215, § 272:—"Spinosae arbores cultura saepius deponunt spinas in hortis . . . . . . Hirsuties loco et aetate facillime deponitur." Again, *l. c.* p. 247, § 316:—"Solum mutat plantas, vnde varietates enascuntur, et, mutato eodem, redeunt. Hinc *Acanthi* molles et aculeati: *Cinarae* aculeatae et non aculeatae."

Similarly, at the present day Pears, species of Rose and of *Prunus*, &c., are well known to lose their spines under cultivation. *Ononis spinosa*, L., has an excessively spiny variety, *horrida*, growing in maritime sands. It is much less spiny in waste places by roadsides, &c., and becomes the variety *inermis* elsewhere. This latter form of the "subspecies" *repens* can be produced, temporarily at least, at will; for when the ordinary spiny form *O. spinosa* is grown either in a very rich soil or with an abundance of water and a moist atmosphere, whether the plants be raised from cuttings or seeds, they gradually lose their spines; those first formed under these conditions are much reduced in size and in rigidity. Hereditary influence is too strong to arrest them at first altogether; although none are produced later on vigorous shoots growing in a saturated atmosphere. They reappear as soon as the same plants are allowed to grow in the ordinary way. It may be added that when the spines are arrested, the peculiar odour of *O. repens* is present, and the flowers also are larger and are like those characteristic of that subspecies *.

M. Lothelier † carried out very similar experiments with other spinescent plants. He thus found that by growing *Berberis vulgaris* in a moist atmosphere it bore no spinescent leaves, as the parenchyma was well-formed between the ribs and veins; but in a perfectly arid atmosphere it bore spines only. Intensity of light also favoured their production. He found from a microscopical examination that in a section of a spine exposed to moist air the vessels of the xylem are few in number and the pericycle is not lignified. In a dry air the xylem forms a continuous ligneous circle and the pericycle is also lignified. I have myself repeatedly corroborated this observation of the special consolidation of fibrous tissues in several instances in different species of desert plants. This consolidation of the mechanical elements may be perhaps explained as a secondary result of the relative abundance of the assimilative tissues; the palisade-layers being often two, three, or even four in number, and equally on both sides of a leaf of a desert plant. While there is a great arrest in area of the parenchymatous tissue—due to the feeble water-supply—the organized products are mainly utilized in the lignification of the supportive tissues.

Conversely, if plants be etiolated by being grown in the dark, while the parenchymatous tissues are relatively in excess, such as the pith and cortex, M. Rauwenhoff has shown that the mechanical tissues are greatly reduced, the assimilative tissues being quite incapable of any activity ‡.

Another instance is supplied by our common Water-reed,

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* Such were the results of my own experiments in 1891–92. I raised plants from the seeds obtained from these plants in 1893, to see if the hereditary trait of producing spines becomes less pronounced in successive generations. In August the plants had only grown to about five inches in height in consequence of the drought; but up to the date of writing this (Aug. 15th) they had developed no spines.

† Revue gén. de Bot. 1890, p. 276; Bull. Soc. Bot. de Fr. 1890, p. 176; Comptes Rendus, 1891, cxii. p. 110.

‡ "Sur les causes des Formes anormales des Plantes qui croissent dans l'obscurité," Archives Néerlandaises des Sci. exac. et nat. t. xii. p. 297.

Phragmites communis. This grass is very abundant in the Nile Valley, growing in places which are not artificially irrigated. It covers large areas of waste ground outside Cairo, forming a stunted growth, the leaves being very short and sharp-pointed. It has been named var. *isarica.* Close to the Nile, however, in Rhoda Island, it grows ten or more feet high, with long leaves almost exactly like the plants in English rivers. In many places the two forms of leaf are on the same stem, sometimes even alternating with each other, suggesting the idea that the leaves were elongated or abbreviated and spinescent, according as the plant happened to have sufficient water at its disposal or not.

In this plant we have, therefore, a varietal character which is quite inconstant, as it varies repeatedly even on the same stem, and which has not become relatively fixed, though deemed worthy of a name.

Such and other facts show how completely relative many varietal and even specific characters may be. They may have every degree of constancy, but they can often and easily change if the environment be altered, till other characters take their place. which may then become relatively fixed in their turn.

I have said that all observations tend to prove that the great reduction of the parenchymatous tissues, with a correlated hardening of the mechanical tissues—so that a spinescent character becomes very characteristic of desert plants—are simply the inevitable results of the action of the environment. That this is so, is corroborated by an experiment of M. Duchartre on the effect of drought upon *Dioscorea Batatas* *.

Some tubers of this plant produced long shoots, but without being allowed to have any water at all. The effect upon the stem was that it acquired excessive rigidity with no heliotropism nor power of climbing. Although the stem was much more slender than normally, there was a marked predominance of the elements of consolidation. The fibres had very thick walls and a minute lumen. The periphery of the central cylinder showed a zone of perceptibly greater thickness than usual, consisting of fibres of small diameter, but with walls of greater thickness than usual. This appears to have been the usual pericycular zone so common in herbaceous endogenous stems. Similarly, the collenchymatous cords at the angles were quite as much developed as in normally grown stems.

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* Bull. Soc. Bot. de Fr. 1885, p. 156.

Moreover, all these well-developed mechanical elements of consolidation in the *Dioscorea* were in a greater relative proportion, in consequence of the considerable reduction which the parenchymatous tissues had undergone.

The leaves were small and undifferentiated, the parenchyma between the veins being much arrested; the stomata were undeveloped and the palisade and lax central parenchyma all alike and unformed in character, except that the two of four larger layers in the centre had no chlorophyll.

From the above brief epitome of M. Duchartre's experiment it will be seen that, so far as the small amount of parenchyma and the great density of the mechanical elements of the fibrovascular tissues are concerned, we have an exact parallel between desert plants and this *Dioscorea* grown without water in the dark. Hence this experiment, together with those referred to above, will suffice to completely justify the conclusion that the indurated character of the mechanical system and also the spinescent features of so many desert plants are simply the immediate results of the effects of the comparatively waterless character of the environment. Lastly, it must be borne in mind that the spinescent character is hereditary, and although the rigidity begins to break down under cultivation in a moist climate and a good soil, the spines may still be formed but become gradually modified and finally disappear, reverting to leafy branches, as has occurred with cultivated pears, plums, and *Ononis*; or back into leaves, as in *Berberis*.

That "xerophilous" peculiarities of plants are not only correlated with but are actually *caused* by the arid conditions of their environment is the conclusion of A. F. W. Schimper [*], who has lately studied the flora of Java. He finds that the plants of the shores, alpine plants, those of the solfataras, and epiphytes, although very different from each other in a classificatory sense, all present common characters in being strictly "xerophilous." In all, the leaves are small and thick, there is a strong cuticle, the stomata being at the bottom of "crypts," the intercellular spaces reduced, hairs more abundant, the water-storage tissues present, &c. The author concludes from his observations that among the causes capable of determining the development of these various adaptations of defence against a temporary or permanent insufficiency of water are the dryness of the atmosphere and soil, a strong insolation and rarefaction of the air, the richness of salts, or a too low temperature of the substratum. The stunted condition of the plants of the solfataras and of the shores would be due to the too great abundance of salts in the substratum, which has the result of reducing the assimilation of carbon.

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[*] "Ueber Schutzmittel des Laubes gegen Transpiration, besonders in der Flora Java's" (Mittheilungen aus den Sitzungsberichten der königl. preuss. Akademie der Wissenschaften zu Berlin, 1890, Heft vii. p. 1045). See also Rev. gén. de Bot. 1892, p. 364.

As a corroboration of the preceding, it may be added that MM. J. Vesque et Ch. Viet * came to the same conclusion, namely, that the fibrovascular structures were much more developed in a dry than in a moist atmosphere.

I will conclude this section by quoting the following corroborative remarks of Grisebach †:—"Au nombre de phénomènes généralement répandus figure le développement des épines, phénomène qui va en croissant avec la sécheresse du climat. Les arbustes épineux plus petits qui habitent les steppes asiatiques et les solitudes du Sahara pénètrent dans les savanes de la contrée basse du Soudan (*Tragacantha*, *Alhagi*). L'exemple le plus remarquable de ce fait est fourni par le Sider (*Zizyphus Spina-Christi*), qui, sous la forme d'un arbuste ou arbre nain, s'étend depuis la Palestine jusq'au Sennaar et au Bornou. Mais dans le Soudan le développement des épines n'est point limité aux arbustes asiatiques de petite taille, ou à la forme de Sodada, puisque même les arbres, notamment les Acacias, aussi bien que les plantes grasses, sont également armés d'organes piquants. Dans la Nubie, la majorité des arbres sont épineux, et il paraît que dans certaines parties de l'Abyssinie et dans le Bornou il n'est presque point de végétal ligneux sans épines. Une chose semblable est rapportée par M. Livingstone relativement aux contrées confinant avec le Kalahari, tandis qu'au contraire cette organisation s'évanouit sur le partage des eaux dans la direction du Congo."

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* "De l'influence du Milieu sur la Structure anatomique des Végétaux," Ann. Sci. Nat., Bot. sér. 6, tom. xii. 1881, p. 167.

† La Végétation du Globe, ii. p. 197.

IV. *Foliage of Desert Plants.*

Another result of the deficiency of water is the small size of the leaves of desert plants, thereby lessening the surface of the transpiring organs; or else they are suppressed almost, if not quite, altogether, as in *Retama*, *Anabasis*, *Ephedra*, and *Tamarix*. Many plants produce moderate-sized leaves in the early spring as soon as the rainy season commences, but none or very small ones later on, as *Zilla*, *Alhagi*, *Statice*, &c. The inrolled margins of the leaves, which make them assume the form of a more or less closed cylinder, is another common contrivance.

Now while this reduction of surface is beneficial by lessening transpiration, we must remember that it is simply the result of drought. This is proved in several ways: first, one and the same plant will produce much larger leaves in March or April, when a good supply of water is at hand, but minute leaves in June, when the supply is deficient; secondly, if the same plant be grown in the Nile Valley it ceases to produce the smaller summer foliage and resembles the ordinary herbaceous leaves of temperate climates. Thus *Salvia lanigera* growing in the Delta has flat leaves, eight inches in length; but when in the Desert they are only about two and a half inches long, with the margins inrolled. A similar variability is a common phenomenon and is well known; for numerous instances might be given of leaves varying in form and structure on the same plant or on different individuals, according as they develop at different times or under different circumstances—or, again, if the plant have been transplanted, say, from a hot to a cold, or from a dry to a wet locality; or, again, from a low to a high altitude or *vice versâ*. Mr. Groom records a case of an orchid, *Renanthera albescens*, which naturally scrambles over plants growing on hot open sandy heaths. The specimen had been transferred to the botanic garden, Singapore, where it was growing under the shade of a well-foliaged tree. As might be expected, the form and anatomical details of the new leaves became much altered. Mr. Groom gives a series of comparisons showing how the cuticle decreased in thickness, while the dimension of the leaf increased in length but was diminished in thickness, &c.*

Mr. Scott Elliot † has independently arrived at a very similar result as to the cause of the small size of the leaves of the "ericaceous" type which prevails in parts of the Cape and of Australia. He observes:—"The climate [of the Karoo] is characterized by a long and dry summer and by plenty of wind. Such conditions obviously favour transpiration . . . Hence the small and excessively coriaceous leaves of these plants without much spongy parenchyma are thoroughly suited to the climate. We may even, I think, go a step further and say that the physical conditions have produced this form . . . With regard to leaves certain observations, which are not yet extensive enough for publication, as to the variation in size and texture of the leaf in the same species in different habitats, strongly incline me to believe that the smallness, cuticularization, and want of spongy parenchyma in the leaf all follow directly from such conditions." Similarly M. E. Warming attributes a similar result to climate, especially the dryness of the atmosphere on the Campos of Lagoa Santa in Brazil. He writes:—"Lorsque les feuilles ne sont pas tomenteuses sur les deux faces, elles sont ordinairement raides et coriaces; les feuilles de plusieurs espèces, agitées par le vent, font entendre un bruit de cliquetis ou de crécelle très extraordinaire; tels sont certains *Salvertia*, *Vochysia*, le *Palicourea rigida* ou *strepitans* et certains *Bombax*. La majorité des espèces arborescentes ont les feuilles dures et coriaces, à quelque famille qu'elles appartiennent" *.

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* 'Annals of Botany,' vii. p. 152.

† "Notes on the Regional Distribution of the Cape Flora," Trans. Bot. Soc. Edinb. 1891, p. 241.

Besides the general reduction in size of the leaves, plants in the desert reach the *subaphyllous* and *aphyllous* conditions. The degradation in the size and form of the leaf passes through many degrees till the leafless stage is reached, as in *Ephedra* and *Retama*. Just short of that, the leaves are minute, scale-like, closely adpressed against the stem, and assume the appearance of the foliage of *Thuja*, *Cupressus*, &c. In the desert this form is well seen in *Anabasis reticulata* and *Salsola Pachoi*. Such leaves may terminate in sharp points, as in *Cornulaca macrantha*, and as seen in our English *Salsola Kali*. This last-named genus, as also *Tamarix*, adopts both forms, just as *Retinospora* may have them, even on the same plant.

That drought is the main cause is inferred from the fact that similar forms occur in plants in rocky and arid mountain regions at high elevations. Thus while the New Zealand nearly aphyllous species of *Veronica* live at an elevation of 7000 feet, *V. thujioides* is found at a lower but still high elevation. Similarly Thujas (Biotas) are trees and shrubs of considerable elevation. So many coincidences here offer the same grounds in support of the contention that similar causes have brought about similar results and produced these mimetic forms in genera of widely different orders. Thus *Tamarix* in Africa may be said to represent *Haloxylon Ammodendron* of Beluchistan and the Oriental steppes (Aitchison and Grisebach), *Casuarina* of Australia, the *Thujas* of Japan and California, *Veronica thujioides* of New Zealand, &c.

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* *Op. cit.* p. 155 [*supra*, p. 218].

V. *Succulent Plants.*

Although spinescence and hairiness are the prevailing features in the desert plants near Cairo, some few are decidedly succulent, as the species of *Zygophyllum*. That this feature is one of the direct results of the intense heat (probably influenced by the presence of salts in the soil), inducing the formation of a thick cuticle, which, in turn, involves the retention of water and the development of succulent aquiferous tissues, I think cannot be doubted. The presence of salts has been proved by M. Lesage to be the immediate cause of succulency in maritime plants of temperate climates *; and he succeeded in making plants succulent which are not so ordinarily. On the other hand, the structure of "rock plants," such as Sedums, Haworthias, &c., is correlated with their arid and stony surroundings (probably without the aid of salts), and is obviously one of the many adaptations for the storage of water.

That the succulency is due to the direct action of the environment, is shown by the results of experiments in which the normal succulency is made to disappear when a new combination of surrounding conditions is supplied to the plant. Thus M. Battandier † cultivated *Sedum Clusianum*, and the leaves at once began to assume a flatter character, and he remarks as a coincidence that the two species *S. stellatum* and *S. tuberosum*, which are not rupicolous in France, but inhabit wet places, have flat leaves. On the other hand, I have found the leaves of *S. stellatum* growing in cracks between flat slabs of rock in Malta, in an exposed heated spot, to be more or less cylindrical. M. Battandier also says that two other species which are not rupicolous but grow in dry earth, viz. *Sedum rubens* and *S. Magnoli*, have flat leaves in a wet season but cylindrical leaves in a dry one.

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* The succulency of several members of the *Chenopodiaceæ* which frequent saline marshes and deserts may be now attributed to the same cause.

† Bull. Soc. Bot. de Fr. 1887, p. 191.

Similarly the common maritime fleshy Samphire of temperate climates, *Crithmum maritimum*, when cultivated in a garden became luxuriant and bore flat and smooth leaves.

Centaurea crassifolia, a plant peculiar to the Maltese islands, growing in hot rocky valleys, has thick succulent leaves which survive during the hot season; but in March, when it begins to produce its new foliage, before the hot summer has approached, I found that the leaves were nearly as thin as in ordinary plants.

As another example, M. Costantin observed * that *Salsola Kali*, a common inhabitant of maritime salt marshes, grows up sandy rivers, when it passes into *S. Tragus* by losing its fleshy leaves.

The most elaborate series of experiments to test the source of the succulency of the maritime plants has been carried out by M. Lesage †, who shows conclusively that the presence of salt is at least a potent cause in its production. He succeeded in *making* plants, such as garden cress, succulent by watering with salt water. He also testifies to the hereditary effect, in that seed obtained from plants of cress which were somewhat succulent in the first year's experiment became still more so in the following.

The increased substance of the leaf is accompanied by a greater development of palisade-tissue with diminished intercellular passages and a less proportion of chlorophyll. This latter result is correlated with a relative decrease in the amount of starch produced.

From all the above facts, natural and experimental, the conclusion is inevitable that while succulency is of benefit to the plants under the conditions in which they grow, especially by enabling them to store water during the hot and dry season, it is in all cases actually brought about by the direct action of the environment itself, coupled with the responsiveness of the protoplasm of the plant.

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* Journ. de Bot., 15 mars 1887.

† Rev. gén. de Bot. vol. ii. pp. 55, 106, 163; see also Comptes Rendus, cxii. 1891, p. 672.

VI. *Protection of Buds.*

A feature very characteristic of the African desert grasses may be here mentioned—namely, the retention of the leaf-sheaths, so that the annual buds are carefully protected against drought when they appear in the spring. Similarly the *Paronychiaceæ* are provided with scarious stipules completely concealing the buds within them. Similarly *Lavandula atriplicifolia* has a spike of densely overlapping bracts (resembling the "wheat-eared" monstrous form of *Dianthus*) protecting the flower-buds. M. Warming noticed the same thing in Brazil. He thus writes:—"Dans le groupe des Glumiflores (Cypéracées et Graminées) les feuilles sont étroites et raides; presque toutes les espèces de ce groupe sont tuniquées au sens où M. Hackel a employé ce mot pour la première fois en 1889, c'est-à-dire que les bourgeons demeurent enveloppés et protégés par la base des feuilles qui persistent pendant longtemps, comme cela a lieu aussi dans le *Posidonia oceanica* (*Andropogon*, *Rhyncospora*, *Scirpus* sp., etc.)." In the African deserts numerous species of *Aristida* illustrate this fact. Lastly, it may be added that bulb-scales may become almost "woody" (*Allium Crameri*, &c.).

VII. *Roots.*

The organs hitherto considered are mostly above ground, but roots also exhibit features of self-adaptation to desert life in the enormous *length* they sometimes attain. Dr. G. Volkens describes [*] how a young plant of *Monsonia nivea* of one year's growth may be seen between July and January to have a small rosette of three or four leaves, while the roots may be twenty inches in length. Other plants may have roots two or more metres long. The Colocynth, he observes, has an enormous length of root in order to maintain its existence. It stands singly, has large herbaceous leaves without any means of preventing an excess of transpiration, as a cut shoot fades within five minutes; and yet it flourishes unshadowed through the whole summer.

The great length of root in certain desert plants has been also noticed elsewhere. Thus Dr. Aitchison observed in Beluchistan that "several of the *Astragali* (*A. kahiricus*, *auganus*, *buchtormensis*) have long whip-like roots, the bark of which is employed as twine by the people. These roots are extracted in a very neat way, by attaching a loop of twine to the crown, passing a stick through the other end and making it act as a lever" [†].

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[*] *Op. cit.* p. 7 [*supra*, p. 220].

[†] *Op. cit.* p. 431 [*supra*, p. 221].

M. de Candolle has also called attention to the advantages of long roots in enabling the plants to resist extremes of temperature. He says:—" L'action de la température est très-sensible à la surface des sols, et l'est moins à une certaine profondeur; d'où il résulte, *1°*, que, dans un terrain donné, les plantes à racines profondes résistent mieux aux extrêmes de la température que celles à racines superficielles; *2°*, qu'une plante donnée résiste mieux aux extrêmes de la température dans un terrain plus compacte, ou moins bon conducteur du calorique, ou moins doué de la faculté rayonnante, que dans un sol ou trop léger ou bon conducteur, ou rayonnant fortement le calorique; *3°*, la nature des plantes et celle du sol étant donneés, les plantes résistent mieux au froid dans une atmosphère sèche, et à la chaleur dans une atmosphère humide" *.

The cause of the long tap-roots of so many desert plants is the well-known responsive power of the apices to moisture, or hydrotropism. Similar phenomena may not infrequently be seen in England. Thus if, for example, the tip of the root of a seedling turnip gets into a field drain-pipe, it may grow to a length of some yards, of course never producing the turnip †. As water is often to be found at various depths below the surface of the desert, the roots stimulated by ascending moisture continue to grow downwards till they attain very great lengths.

Duration.—Some desert plants are usually annuals, the majority being perennials. A feature, however, which Dr. Volkens notices is that these characters are particularly liable to change in desert plants according to circumstances. Plants which normally live but one year, as species of *Savignya*, *Polycarpon*, *Malva*, *Trigonella*, *Ifloga*, &c., may survive two or more years; while perennials, like *Capparis*, *Tamarix*, *Nitraria*, *Retama*, *Acacia*, &c., may become annuals. The fact is that it simply depends upon the depth to which the primary tap-root descends so as to secure a more continuous supply of water below the surface, which enables the plant to survive the hot season.

Mr. Scott Elliot has observed the same fact in South Africa ‡. In speaking of the prevalence of the "ericaceous" type, including 350 species of *Erica* itself, he remarks:—" It is not, I think, hard to see why this type should obtain so largely in the S.W. district. There is, to begin with, no winter worthy of the name; and therefore annuals would, when becoming acclimatised, probably cease dying at the end of the year, because there is no reason why they should. Certain European annuals of cultivation have, in fact, become perennials."

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* 'Essai élémentaire de Géographie Botanique,' Dict. Sci. Nat. tom. xviii.

† I have such a specimen, which was brought to the late Prof. J. S. Henslow by a villager in Suffolk about the year 1850.

‡ *Op. cit.*, Trans. Bot. Soc. Ed. 1891, p. 244 [*supra*, p. 228].

Now the annual, biennial, or perennial character of plants is often regarded as specific; but it is one which can be easily changed, and may then become hereditary: thus the garden form of the carrot is *now* biennial, but normally, as a wild plant, *Daucus Carota*, it is an annual. This is simply the result of sowing the seed of the original wild form *late in the season.* The consequence was that the plants did not blossom till the following year. Then, by selection, this biennial feature has been fixed, and is now hereditary.

Poa annua, if grown in plenty of moisture, at once becomes a perennial; as it does also on the Alps, just as several other annuals at lower altitudes, as well as latitudes, become perennial when growing at higher altitudes and latitudes.

Mr. Th. Holm * has recorded a number of examples of American plants which are ordinarily annuals, but become perennial under exceptional conditions. They include *Hypericum nudicaule*, *Delphinium Consolida*, *Cyperus flavescens*, *Carex cyperoides*, and species of grasses and Crucifers which are annuals in Europe, but perennials in the United States, and particularly so near Washington. For example, *Arabis dentata*, which is typically biennial, and *A. lyrata*, which is normally annual or biennial, have formed perennial specimens. On the contrary, *A. lævigata*, said to be perennial by Hildebrandt, is not at all rare as a biennial near Washington.

This change in duration may be accompanied by a change in the period of flowering; or the period of flowering may change without a plant altering its duration of life. These alterations may become permanent. Thus, Sir J. D. Hooker † noticed how the stock and mignonette become perennials in Tasmania; on the other hand, the castor-oil becomes an annual in England.

As a remarkable instance of a plant having undergone a complete change of season in flowering, *Oxalis cernua* may be mentioned. This is a native of the Cape of Good Hope, and flowers in the winter, *i. e.* July; but throughout the whole of the Mediterranean border, where it has become dispersed since 1806, it blossoms from November to April *.

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* "On the Vitality of some Annual Plants," Amer. Journ. Sci. xlii. 1891, p. 304; also Rev. gén. de Bot. 1892, p. 364.

† Animals and Plants under Domest. ii. p. 305.

Mr. Darwin has so fully discussed, under the head "Acclimatization" †, the variability of plants in adapting themselves to climate, and so becoming "precocious" or "late" in flowering, that I need not enter upon this subject. All I would contend for is that such variations of habit are simply due to the responsiveness of protoplasm to the environmental conditions, and that, when once acquired, they all tend to and may become hereditary traits.

In corroboration of this I will conclude with the following observations by the late Dr. Lindley ‡:—"It often happens that, as in peas, the tendency in such plants to advance or retard their season of ripening *was originally connected with the soil or climate* in which they grew. A plant which for years is cultivated in a warm dry soil, where it ripens in forty days, *will acquire habits of great excitability*: and when sown in another soil will, for a season or so, retain its habit of rapid maturity; and the reverse will happen to an annual from a cold and wet soil. But as the latter will gradually become excitable and precocious if sown for a succession of seasons in a dry warm soil, so will the former lose those habits, and become late and less excitable."

VIII. *Histological Peculiarities of Desert Plants.*

Although the morphological features of desert plants are obviously adaptive, the histological elements illustrate the same fact even in the most minute details §.

Epidermis and Cuticle.—Commencing with the epidermis, a thickened cuticle in various degrees is of well nigh universal occurrence. There is also very frequently a superficial layer of wax. The cuticle is often covered with waved lines or ridges, especially on elevated cells, and the hairs with tubercles.

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* See my paper on "The Northern Distribution of *Oxalis cernua*, Thunb." Proc. Linn. Soc. 1890–92, p. 31.

† Animals and Plants under Domest. ii. p. 305.

‡ 'Theory of Horticulture,' p. 465. (The italics are mine.)

§ The reader might consult M. Vesque's descriptions and figures of species of *Capparis*, showing how their anatomical structure conformed to their habits. "L'Espèce végétale considérée au point de vue de l'anatomie comparée," Ann. Sci. Nat. sér. 6, t. xiii. 1882, p. 5.

M. Dufour[*] found experimentally that the thickness of the external and lateral walls of epidermal cells is greater under sunlight than is that of the same species when grown in the shade; and the cuticle is also much more developed under sunlight.

It need hardly be pointed out that in the desert the sunlight and glare reflected from the sand are very powerful, and therefore, *cæteris paribus*, the intensification of those elements mentioned is just what would be, on *à priori* grounds, expected from M. Dufour's experiments. But the thickness of the cuticle tends powerfully to prevent the loss of water, which is the end and aim of all desert plants in their adaptations to the climate.

Dr. Volkens[†] observed that a considerable number of xerophile plants are protected against a too energetic transpiration by the existence on the surface, outside the cuticle, of a thick layer of a sort of varnish, very brilliant in appearance. It is in great part soluble in alcohol, and without doubt of a resinous nature. An interesting fact, from the point of view of geographical botany, is that such plants are peculiar to the southern hemisphere.

The presence of wax on the surface of leaves was long ago observed by Mulder to be closely correlated with chlorophyll; so that when we find the palisadic layers much increased, as they are in desert plants, we should, *à priori*, expect a specially increased layer of wax. The production of this substance is dependent ultimately upon the increased amount of light [and heat ?], which appears to deoxidize chlorophyll, and to leave wax as one of the products; hence the epidermis becomes colourless and the cuticle coated with wax, as the wax increases with the loss of water. Upon this Mr. Herbert Spencer observes:—"The deposit of waxy substances next to the outer surface of the cuticular layer in leaves is probably initiated by the evaporation [transpiration ?] which it eventually checks"[‡].

When the external walls of epidermal cells are flat, the cuticle is generally smooth; when, on the contrary, each cell forms a convexity towards the exterior, it is nearly always ornamented, either with parallel and straight or undulating striæ, or they may be more or less reticulated, &c. The above features are common in desert plants. M. Vesque offers the following interpretation *:—“ Il serait bien difficile de déterminer le rôle de ces dessins cuticulaires par l'expérience; mais étant donnée cette circonstance singulière que les épidermes plans en sont ordinairement dépourvus, tandis que les parties convexes en présentent presque toujours, il est permis d'émettre une hypothèse à mes yeux fort plausible. Chaque cellule convexe représente en effet une lentille convergente qui, malgré ses faibles dimensions peut, surtout dans les pays chauds, notablement surélever la température en un point déterminé de la cellule épidermique ; il est donc important, dans ce cas, de remplacer la vitre lisse par une vitre cannelée qui a pour effet de disperser, d'égaliser la lumière incidente; de cette manière on comprend pourquoi, dans un grand nombre de cas, les cellules convexes qui avoisinent les stomates ou les poils enfoncés au-dessous du niveau de l'épiderme et celles qui se relèvent en petites sallies autour de la base des poils sont striées tandis que les autres ne le sont pas.”

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[*] Ann. des Sci. Nat., Bot. sér. 7, tom. v. p. 311, t. viii.

[†] "Ueber Pflanzen mit lackirten Blättern," Berichte der deutschen botan. Gesellschaft, Bd. viii. Heft 4, p. 120 (1890).

[‡] 'Principles of Biology,' ii. p. 245.

As far as sheets of glass with striated and reticulated surfaces can imitate a cuticle, I find that a sheet of sensitive paper is not darkened to the same extent under them as under a clear sheet of glass of the same thickness when fully exposed, and for the same time, to sunlight; though nothing could be deduced from any differences of temperature under the same circumstances.

Pilosism.—Since a more or less excessive hairiness is a characteristic feature of the great majority of plants growing in hot and barren deserts, the question arises as to what is the cause. Now any extra outgrowth, even if it be but epidermal trichomes, implies the presence of more nutritive materials at the disposal of the plant at the spot than when they are not formed at all. M. Mer, who studied the question, came to the conclusion that, *cæteris paribus,* hairs are due to a localized extra nourishment, and therefore frequently occur upon the ribs and veins, *i. e.* immediately over the channels of sap. He thinks this view is supported by such a case, *e. g.*, as *Rhus Cotinus*, in which the abortive pedicels, which bear no fruit, develop a large amount of hairs, while the pedicels which bear fruit have few or none. The excess of hair is therefore presumably due to a compensatory distribution of sap.

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* *Op. cit.* p. 34 [*supra*, p. 235, note].

M. Aug. Pyr. de Candolle came to the same conclusion in 1827; for he thus wrote about *Rhus Cotinus*:—"Peut-être la sève destinée à nourir les fruits ne trouvant plus d'emploi, lorsque ceux-ci ont avorté, produit-elle ce développement extraordinaire de poils. Quelques filets d'étamines (*Verbascum*, *Tradescantia*) deviennent aussi poilus quand les anthères avortent, et probablement par la même cause"[*].

Dr. M. T. Masters observes, when speaking of the hair on the barren pedicels of *Rhus Cotinus*, or the "Wig-plant," as it is called:—"A similar production of hair may be noticed in many cases where the development of a branch or of a flower is arrested; and this occurs with especial frequency where the arrest in growth is due to the puncture of an insect, or to the formation of a gall"[†].

As an illustration of this last-mentioned fact, it may be often noticed how *Veronica Chamædrys* terminates its shoots with an excessively woolly globular bud. A similar thing happens to a heath, *Erica scoparia*, common on the hills around Cannes. In the latter plant the abnormal leaves are broad, ovate, and densely hairy; while the ordinary leaves are linear and glabrous. These globular structures in both plants are due to the irritation set up by the presence of grubs. The axis and the innermost leaves are arrested at the apex, while in compensation the lower leaves of the bud alter their character, enlarge and become densely clothed with hair [‡].

The fact of hairs being developed over and about the fibrovascular cords is of common occurrence, and, under the above aspect, becomes very significant in such cases as in desert-grasses, lavender, &c. Pfitzer observes, "Almost all grasses inhabiting very dry localities have leaves with well-marked longitudinal folds"[§], the stomata being situated within the grooves, while the ridges correspond to the vascular and fibrous cords. The toothlike (or branched, as *e. g.* on the calyx of Lavender) hairs of the grasses project like *chevaux-de-frise* over the grooves. They have swollen bases capable of imbibing moisture; and so in all probability absorb dew, as well as protect the surfaces against a loss of water. The marginal inrolling of the blade is, of course, an additional protection. To such an extent does this occur, that many blades of desert-grasses are perfectly cylindrical; the upper surface, which is the especially grooved one, being entirely concealed from view, as may be well seen in Volkens's figure of *Aristida ciliata* *. In some cases, as in this grass, certain hairs assume a papillate form immediately over the stomata.

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[*] 'Organographie Végétale,' tom. i. pp. 111, 112.

[†] 'Teratology,' p. 472.

[‡] I have elsewhere called attention to this fact in its analogy with the results of the irritating action of the pollen-tube. See 'Origin of Floral Structures,' p. 164 *seqq.*

[§] Quoted by De Bary, Comp. Anat. &c. p. 50.

As another illustration which seems to support M. Mer's contention that hairs are, *cæteris paribus*, a result of compensation, M. Lesage † found in a root of the second order of *Phaseolus*, which was much longer than the primary root, that the portion *outside* the water was covered with numerous root-hairs; *near* the water these hairs were elongated, while *in* the water they were much shorter, and finally disappeared altogether. In a transverse section it was seen that the cortical layers in the air contained smaller elements than those in the water; and in the central cylinder the xylem was proportionally more lignified in the aerial portion.

The root of the bean was made the subject of similar observations. It was found that when numerous secondary roots were suppressed, the primary root was covered with numerous absorbing hairs.

The above interpretation will, therefore, satisfactorily explain the existence of the hairiness of plants in the deserts; for drought, aided by the barrenness of the soil, tends to arrest the development of parenchymatous tissues; and in proportion as this arrest is excessive, so is the compensating process of the production of hairs. Hence, just as with plenty of water or a good soil, as obtains under cultivation, plants tend to become less hairy than in the wild state, as *e.g.* the parsnip, so, conversely, under aridity and a poor soil, hairiness becomes a characteristic and hereditary feature.

Here again, therefore, if the above explanation of M. Mer's be true, the very conditions which bring about the production of an excessive clothing of hair are precisely those against the severity of which this dense clothing is one of the very best of protections.

The above interpretation receives indirectly an additional countenance from the fact that just those desert plants which *do* develop much parenchyma and become exceedingly fleshy, as the *Aloineæ*, *Euphorbiæ*, *Cactaceæ*, *Zygophyllum*, &c., are generally entirely hairless.

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* *Op. cit.* pl. xvii. fig. 4 [*supra*, p. 220].

† Comptes Rendus, cxii. 1891, p. 109.

Intense hairiness is certainly one of the most conspicuous features of desert plants, and is an invaluable means of lessening the heat by forming a non-conducting surface; and, on the other hand , is ameans of absorbing dew during the summer when no rain falls.

Dr. G. Volkens remarks that a multitude of cases establish the empirical deduction that drought is correlated with the presence of much hair, though what the real causal connection may be is not so clear to him*. He observed that as transpiration tends to increase, so does the relative quantity of hair, till (it may be added) the quantity becomes so great as to check the very process which may have had something to do with bringing it about.

In desert plants the hairs are of different forms. They may be stiff, straight, and adpressed to the surface, all lying in one direction; or the "needles" are interlacing; or the hairs may be of a twisted cottony character and cover the surface with a layer of wool; or, again, they may be stellate and flat, the branches interlacing so as to produce a dense coating of felt; or they may be bladdery and filled with water. These latter may finally collapse, dry up, and form a glassy sheet.

There are also peculiarities in the structure of the hairs themselves which are remarkable. In many cases the cavity is quite filled up with the exception of the broad basal part of the cell, while the outer surface may be densely coated with wax, either entirely or with "gashes" and "pores" (*Diplotaxis Harra*), or else the basal portion is quite devoid of it (*Heliotropium luteum*), so that water can readily pass from without into the interior. Dr. Volkens observes, with regard to the filling up of the lumen with cellulose matter, that this is connected with the swelling up of the inner membrane, and shows (by treatment with suitable reagents) that it is a substance which, when water is absorbed, can hold it fast with great strength. This, of course, greatly retards transpiration.

I have found in some cases, besides the closely applied felt, that there are taller branching hairs standing much above the level (*Erucaria aleppica*). These I take to be specially absorbing hairs, as well as all which have no wax, or at least places where it is wanting.

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* He makes no allusion to M. Mer's observations, which were probably therefore unknown to him.

As a special peculiarity, I have found in *Cocculus Leæba* a basket-like arrangement of hairs round the axillary buds. This would presumably retain a large drop of dew, by means of which the bud would be benefited.

Besides being actual absorbents of dew*, it may be borne in mind that not only does the felt collect the dew-drops, which get entangled in it and so get absorbed, but it parts with them by evaporation much more slowly than does a smooth leaf, as I have tested by experiment with many kinds of leaves.

Now, as Dr. Volkens observes, though *suspected*, he cannot say for certain how or why the hairiness is produced. But, besides, the reasonable interpretation of M. Mer which I have given above, that hairiness is a direct result of the environment upon the plant, is established by numerous cases. In the first place we have "the argument of coincidences," as I would call it; but when we find that a change of habitat brings about a greater or less degree of hairiness, the *probabilities* accumulate till they amount to a moral conviction, which is further established by experimental verification. Thus, for example, the hairiness of wild plants tends to decrease under cultivation, as in the wild parsnip. Linnæus observed this fact nearly two hundred years ago for he says†:—"Spinas et hirsutiem . . . plantæ sæpius exuunt a loco vel cultura." *Ranunculus repens* growing in a dry barren gravelly soil is very hairy, but another plant growing in water ten feet from the former, which I have preserved, is scarcely hairy at all.

M. Battandier observes ‡ that *Bellis atlantica*, with leaves covered with a true velvet having a long pile, at the summit of the mountain Blida, when cultivated in Algeria, bore leaves less and less velvety till they finally became as glabrous as the *Bellis* of Algeria.

Similarly *Allium Chamæmoly*, when cultivated for eight years, lost its villosity which it had on the summit of Zaccar. So also

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* For proof that plants *can* absorb rain and dew by their green parts, I would refer the reader to my paper "On the Absorption of Rain and Dew by the Green Parts of Plants," Journ. Linn. Soc., Bot. xvii. p. 313.

† Philos. Bot. § 272.

‡ Bull. Soc. Bot. de Fr. 1887, p. 193.

Cerastium Boissieri, which is white and tomentose at the summit of Aït-Ouabau, became glabrous and of a beautiful green at Algiers.

Hairiness is well known to be a most variable character, and although it is recognized as specific when constant and abundant, as in *Verbascum*, and therefore less variable, it obviously becomes much less important when it fluctuates.

It may be observed here that the hairiness as an hereditary character varies greatly. Thus, M. Battandier found that *Bellis atlantica* varied *when transplanted*, yet when raised by seed in Algeria did not show similar modifications; similarly *Allium Chamæmoly*, though it was less villous, remained more hairy than its congener after cultivation as well as by sowing. On the other hand, seedlings of *Pastinaca sativa* raised in a prepared border in the botanic gardens of the Cirencester Agricultural College became less and less hairy, and finally quite glabrous*.

As a spontaneous variety, *Malva parviflora* may be mentioned; as grown in the Nile Valley as a culinary vegetable it is not very hairy, the hairs being stellate, having only a few rays, sometimes two only. As a desert plant, where it appears as a small annual for a few weeks only, the stellate hairs increase their number of rays. Similarly *Erodium laciniatum* is much less hairy when growing in waste ground on Rhoda Island in the Nile by Cairo than when in the desert. I find that the main differences between the two forms may be summed up as follows:—Hypodermic collenchyma is much thicker in the petiole of the desert form. The upper epidermis has its cells similar in size but with more hairs. The lower epidermis has cells which are much smaller than those of the Nile Valley form. The palisade, consisting of two rows of cells, is identical in both cases below the upper epidermis; but while there is a lax mesophyll of rounded cells on the lower side in the Nile Valley form, the corresponding cells are somewhat elongated in shape, thus tending to assume the palisadic type characteristic of the lower side as well as of the upper in the desert form. Hairs of the latter are more numerous in the proportion of 24 to 10 for the same area.

STOMATA.—These structures are frequently sunk below the level of the outer surface of the leaf and may occur on both sides. The depression in which they lie is either in consequence of the great thickness of the outer wall of the epidermis (*Allium Crameri*, *Pityranthus tortuosus*, &c.), or because the epidermis itself lines cavities in the parenchyma which are either naked or clothed with hairs covering over the stomata, as in the grass *Danthonia Forskåli*, very like the well-known case of *Nerium Oleander*, to which M. Vesque adds *Capparis Breynia*. The Oleander has narrow, rigid, more or less erect leaves which are well suited to live in a dry atmosphere. In a specimen growing at Cannes there was a thick cuticle and two layers of thick-walled hypodermic cells, a palisade-tissue of two layers on the upper side and of one layer on the lower. A lax mesophyll of green cells fills up the central space. The stomata are on the bottom of the epidermal cavities.

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* Prof. Buckman raised the "domesticated" variety alluded to in 1847, which he called the "Student." It is still regarded as the "best variety" in cultivation, according to Messrs. Sutton & Sons of Reading (1894).

In a leaf gathered from a tree in Cairo, there were slight differences, in that there happened to be no palisade-cells on the lower side at all, the lax mesophyll reaching to the hypodermic layer. Such differences are probably accidental; but they show clearly how easily the anatomy of a leaf conforms to slight differences of illumination, &c.

In desert plants the guard-cells are often so thick-walled that the lumen is nearly obliterated; and, contrary to what is generally supposed to be the case in temperate regions, Dr. Volkens shows that they often close during the day and are open at night*. Perhaps the arrested moisture due to the check to transpiration may cause turgescence by day, which closes the slit, while the cessation at night brings about a relaxation; or it may be the result of a more complicated action between the guard-cells and the adjacent epidermal cells. It is, however, difficult to say without a very close investigation into the phenomena on the living plants in their natural conditions.

IX. *Assimilative Tissues.*

The chlorophyll-tissue of an ordinary dorsi-ventral leaf is typically differentiated into a palisadic layer below the upper epidermis and a spongy layer above the lower epidermis. It is well known that in those plants in which the leaf is normally reversed in position, as *Alstrœmeria*, the relative positions of these two layers are also reversed. This inversion can be more or less decidedly brought about by compelling certain leaves to develop their surfaces reversed. Moreover, when leaves assume a vertical position, so as to be equally illuminated on both sides, then the epidermis and subjacent palisadic tissue are also more or less alike, as in some grasses, the phyllodes of Australian Acacias, the pendulous falcate leaves of gum-trees, though the first-formed horizontal leaves on the same gum-trees are dorsiventral in structure like ordinary horizontal leaves *.

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* Die Flora der aegypt.-arab. Wüste, p. 47.

The preceding facts all conspire to prove that the differentiation of the mesophyll into palisadic tissue is the direct result of illumination; and that, as the upper surface of normally horizontal leaves receives more light than the lower, the differentiation of the chlorophyll-cells into an elongated form parallel to the incident light is the direct outcome, *cæteris paribus*, of that external agent.

A significant fact with regard to these alterations is that the change evinces itself by degrees. Thus in young leaves of *Alstrœmeria psittacina*, M. Dufour † shows that it is only partially effected. Thus the first leaf stands vertically. It possesses few stomata, and is nearly alike on both sides. The second leaf is still nearly vertical, being only twisted towards the apex. It has stomata on both faces at the base, but at the point shows many upon the upper, but none on the lower side. The subsequent leaves have the petiole twisted and are completely reversed in position; their petioles have a small number of stomata on the two faces in the limb, exclusively upon the superior face, now become the lower in position. Another interesting point is that in young leaves the mesophyll is homogeneous; but the cells under the upper epidermis are rather larger at first in the older leaves, showing an hereditary tendency to develop palisade-tissue; but later on the influence of the light soon renders the cells below the—now reversed—inferior side much longer than the others.

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* The chief differences between the two forms of leaves in *Eucalyptus* I find to be as follow:—In the horizontal leaf the upper epidermis is composed of small cells and there are no stomata. There is a palisade-tissue of one layer of cells, with lax mesophyll below the lower epidermis. This latter has larger cells than the upper and is provided with stomata. The pendulous leaf is a good deal thicker than the horizontal. Both epidermides are provided with a very dense cuticle in which the stomata are deep-seated. There are four rows of palisade-cells on both sides with a chlorophyllous mesophyll between them. The petiole is flattened so that the leaf can swing much in the same way as that of the Poplar. The horizontal leaves in *E. Globulus* are sessile.

M. G. Briosi has written a voluminous work with many plates upon the leaves of *Eucalyptus Globulus*, Labil., to which the reader is referred for numerous details ('Intorno alla Anatomia delle foglie dell' *Eucalyptus Globulus*, Labill.,' 95 p. et 23 pl., Milano, 1891).

† Bull. Soc. Bot. de Fr., 28 mai, 1886, p. 269. The author here gives several references to the literature of the subject.

The needle-like leaves of the Norway Spruce prove, according to the careful investigations of M. Mer *, to be most remarkably sensitive to light—becoming more quadrilateral with a uniform palisade-tissue as the leaf grows exposed, but flatter and more dorsi-ventral when it is more shaded on the same tree.

He also observes the remarkable result of frost setting up a "habit" in the tree, as follows:—"Trees planted isolated have some modifications. They become more bushy, from the development of lateral buds, which are arrested in forests. When the young shoots are struck by frosts in the spring it happens at times that, without reaching the point of death, they lose their turgescence. They become soft, and their extremity turns towards the ground. Lignification supervenes before they have recovered their turgescence, and they remain thus definitely curved. When the terminal bud is not destroyed it develops its succeeding shoot the following year in this position. If one places it vertically, the terminal bud turns downwards, and the branch in course of development preserves this situation; or rather its extremity tends to elevate itself by a slight curvature. This depends upon its degree of vigour and the time during growth when the experiment is made."

This passage is very suggestive as a cause of "weeping" varieties of trees, by a *temporary* injury producing a *permanent* effect in the growth, though not to the extent of being hereditary.

Again, Dr. F. Noll † has shown that external influences determine not only the *direction* of some organs, but also the *position* in which they are formed; as, *e. g.*, the development of the gemmæ of *Marchantia*, of aerial roots on climbing plants, &c. In other and more numerous cases the formation of fresh organs appears to be independent of external forces, and to be determined only by the internal, *i. e.* hereditary, forces in the plants; as, for instance, in the dorsi-ventral structure of many parts of plants. In *Bryopsis* the reversal of the plant brings about a corresponding internal organic transformation.

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* Bull. Soc. Bot. de Fr. 1883, p. 40.

† See Journ. Roy. Micr. Soc. 1891, p. 490.

M. Warming notes the same feature in the leaves of plants growing in the arid campos of Lagoa Santa. He says *:—"La direction des feuilles accuse également la sécheresse du climat; beaucoup d'entre elles ont habituellement une direction verticale ou sont au moins très relevées, de manière à n'être frappées par les rayons solaires que sous un angle aigu. Certaines espèces ont des feuilles très réduites et quelques-unes sont aphylles; elles appartiennent à des familles très différentes." The reader will perceive that this description would apply equally well to many desert plants of the northern hemisphere.

Applying the preceding observations to desert plants :—If a leaf be small, narrow, and moreover assume a more or less vertical position, as is so generally the case, so that it is illuminated nearly equally on both sides, we should expect to find on *à priori* grounds that it would have palisade-tissue on both sides. Such is precisely the case with innumerable desert plants. The only and indeed relatively rare exceptions are in the leaves of such plants as develop their foliage during the rainy season, as annuals, or in "Nile Valley" plants which happen to secure a place in the borders of the desert. Such have a more or less characteristic spongy parenchyma on the underside; while transitions from this to true palisadic tissue are easy to be found. The typical chlorophyll-tissue in leaves of true desert plants is therefore palisadic on both sides, the cells being arranged in from one to four or even five superposed rows. These sometimes meet in the middle (*Zizyphus Spina-Christi*), in others there is a central layer of short rounded cells (*Cassia obovata*), the usual lax merenchyma being entirely wanting.

In addition to the typical palisadic cells at right angles to the surface, large cells palisadic in shape may be arranged in cylinders around the fibro-vascular bundles. This is particularly well seen in grasses; but within this cylinder is a second, of chlorophyllous cells, which are quadrate and short in form. This peculiar arrangement of a double cylinder of green cells is not confined to grasses, but occurs in exogens, as *Tribulus alatus*, *Atriplex Halimus*, &c.; so that in all cases the fibro-vascular cords are densely imbedded in chlorophyllous tissue.

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* *Op. cit.* p. 155 [*supra*, p. 218].

In some cases the inner sheath is colourless and acts as a water-storage tissue (*Oligomeris subulata*). It is, I think, really homologous with the endoderm.

M. Dufour * found that chlorophyllous tissue is much more developed in sunlight than in shade; and it may be added that a similar phenomenon occurs in Alpine plants and plants of high latitudes as compared with the same species growing at low altitudes and latitudes. In these cases the deeper green tint is also due to the uninterrupted sunlight. Hence it is not surprising to find the chlorophyll-tissues reach a high development under the intense light in the desert, whether from the sun direct, or reflected upwards from the sand.

X. *Ligneous Tissues.*

Messrs. Dr. D. H. Scott and G. Brebner have described † the histology of *Acantholimon glumaceum* (Plumbagineæ), and Prof. D. Oliver had previously examined ‡ that of *Acanthophyllum* as well (Caryophylleæ). These are both desert plants; and I might now add a great many more anomalous and subanomalous stems of plants growing in the North-African deserts, some of which Dr. G. Volkens has described and figured §. The general conclusion deducible from a study of their peculiarities is that these are due to the climatal conditions under which they grow. Summing them up, they may be enumerated as follows:—There is a general tendency to lignification; with an absence of medullary rays (*Zilla myagroides*, *Bassia muricata*); if they be present, they are comparatively few and have thick walls (*Farsetia africana*, *Helianthemum kahiricum*, *Ochradenus baccata*); the fibro-vascular cords may form "islands," as seen in a transverse section, imbedded in dense tissue (*Statice pruinosa*, *Atriplex leucoclada*, *Pityranthus tortuosus*); the "wedges" of wood may fail to form a regular zone, but be more or less isolated and imbedded in water-storage tissue (*Tamarix mannifera*, *Anabasis articulata*). The wood may be deeply indented with cortical invasions, as Prof. Oliver has shown to be the case in *Acanthophyllum*. Dr. Scott observes that this is due to the fact that the zone does not close up after having early parted with a cord for an appendicular organ. I think we may attribute this failure to a want of activity in the formation of wood, which may be correlated to the insufficiency of foliage during the hot months[*]. Perhaps the curious cavities described[†] by Prof. D. Oliver in a species of *Acantholimon* as occurring in the wood may be attributed to the same cause.

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* Ann. des Sci. Nat., Bot. sér. 7, tom. v. p. 311.

† Ann. of Bot. vol. v. p. 259.

‡ Trans. Linn. Soc. vol. xxii. p. 289.

§ Die Flora der aegyptisch-arabischen Wüste, &c.

As other examples of anomalous stems, Dr. Volkens describes and figures that of *Gypsophila Rokejeka*: the pericycle (which is often very active in the Caryophylleæ) puts on a very dense zone of thick-walled sclerenchyma, in lieu of xylem, which in this plant is comparatively feeble. A similar result occurs in *Telephium sphærospermum*, of the allied order Paronychiaceæ. I have found an analogous result of pericycular activity in *Iphiona mucronata*. Inside a cortex there are zones of square, oblong, or irregular shaped patches of sclerogen imbedded in a parenchymatous tissue[‡], and only isolated patches of xylem around the medulla, all being imbedded in a "stereome-zone." *Astragalus Forskålii* has a very anomalous stem. It has large cords of liber outside a zone of cork, then another series outside the phloem, a third, *complete* zone in the middle of that tissue. An anomalous xylem follows surrounding a medulla in the centre of which is a column of collenchyma! To this I would add the stem of *Anabasis articulata*, which has only rudiments of leaves, opposite and distichous. All the elements, as seen in a transverse section, make up four series of crescent-shaped structures around an hourglass-shaped pith. Taking a "wedge," there is sclerenchyma forming the angle, then a zone of large vessels and wood-fibres, then cortical parenchyma, and sclerenchyma outside.

It may be observed that the four wedges, roughly resembling a Maltese cross, here appear to be correlated to the positions of the rudimentary leaves; the xylem tissues failing just were no leaves occur.

As long as the shoots are young and green, one may add to the above peculiarities of stems the great thickness of the cuticular surface of the epidermis, which is not infrequently clothed with hair like that of the foliage; the great depth of the palisadic layer, which often consists of three, four, or more zones of elongated cells (e. g. *Zilla*), the cortex acting as a storage-tissue for water, subsequently passing over into cork.

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[*] I find that Grisebach confirms this idea, for in speaking of the partially developed wood in *Haloxylon Ammodendron* he says:—"La suppression du feuillage détermine la croissance incomplète du corps ligneux" (La Vég. du Globe, i. p. 630).

[†] *L. c.* tab. 51. fig. 24.

[‡] Dr. Volkens figures a section of a *young* stem; but does not appear to have noticed the development of pericycle.

Now, when we observe how often the different members of the tissue of stems of woody desert plants are thus variously disposed and constructed, while at the same time there are certain general features very commonly to be seen throughout, I think we cannot fail to arrive at the conclusion that these structures are simply the outcome of the environment in which such plants live. This view is corroborated by experiments, for they prove that the great tendency to lignification of the tissues, as already shown for the spinescent features, is a result of a deficiency of water, and they at once tend to disappear when desert plants grow in an ordinary prepared soil of cultivation.

This, for example, is well seen in several species which frequent both the Desert and the Nile Valley, and in the plant of *Zilla myagroides* already alluded to, which was raised from seed in Cairo. The spines were quite flexible, the pericycular sclerenchyma, which is very dense and thick-walled in the desert plants, being very greatly reduced under cultivation.

We have also seen, from Duchartre's experiment with *Batatas*, that the absence of sufficient water is a direct cause—in conjunction with the responsiveness of protoplasm—of a comparative increase of lignification. To this we may add the great defection of foliage in the hot summer months, when the formation of tissues is proportionally arrested. We can thus realize how anomalies in the structure of the stems may well be expected, though we may not be able to explain in the case of every individual stem the direct connection between cause and effect.

XI. *Water-storage Tissues.*

One of the most characteristic features of desert plants is their system of storing water. Commencing with the epidermis, certain of the cells form rounded or oval elongated bladders bulging on both sides; or they may elongate into hairs, the lower part acting as a storehouse of water, or they may assume the form of bladders supported on short pedicels. As an example is the familiar ice-plant which occurs about Alexandria, being so called because the water-cells are so conspicuous over the surface of the leaf. Many other plants are provided with them, but they are not so conspicuous to the naked eye; thus species of *Reseda* (as *R. arabica*), *Gypsophila Rokejeka*, *Malcolmia ægyptiaca*, *Heliotropium arboreum*, *Hyoscyamus muticus* *, &c. *Atriplex leucoclada* has globular water-cells on slender supports; in this, as in *Atriplex Halimus*, the hairs finally collapse, and by sticking together form a sort of protecting sheath all over the surface of the leaf.

In the interior of the leaf the chlorophyll-tissue is sometimes so abundant that the leaf is perfectly green throughout; in other cases the central tissue is nearly or quite devoid of chlorophyll-grains and acts as a storage-tissue. In *Atriplex Halimus* the outer layer of palisade-cells is clear and utilized as storage; while in some, as *Nitraria retusa*, large isolated storage-cells lie imbedded within the palisadic tissue, some others of the elongated cells being reservoirs of tannin.

Of the above varieties the central storage-tissue is the most important and is well seen, as it occupies by far the greater space, in such succulent leaves as those of *Mesembryanthemum* and *Aloë*.

Sign. Arcangeli has lately observed that *Atriplex nummularia* possesses below the epidermis of the leaves an uncoloured parenchyma which covers the assimilative layer and represents a tissue of water-storage †.

In stems the cortex and medulla act as storage-tissues, the former gradually passing into cork, which of course is a great protective tissue in many desert plants.

Of subterranean structures the bulb-scales of species of *Allium*, *Pancratium*, &c., and the cortical region of roots of grasses, may act as storage-organs.

In some exogens the roots and subterranean stems assume special forms which act as reservoirs. Thus, in the genus *Erodium* there are three desert species which develop tuberous structures on the roots, which Dr. Volkens proved to be water- and not starch-storing tissues. This observation has been corroborated on quite independent grounds by M. Hackel *, who has called attention to similar structures and their usage in certain grasses of dry climates; these being singular developments of the lowest internodes of the culms, shoots, and basal leaves.

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* The epidermal water-cells give a pale green colour to the leaf, and render it difficult to dry completely, except after many days in the press; perhaps because the water in all the plants is more or less thickened by gummy or other matter.

† "Sulla struttura delle foglie dell' *A. nummularia*, Lindl., in relazione alla assimilazione" (Nuovo Giorn. Bot. Ital. vol. xxii. p. 426).

He distinguishes them as tuberous or bulbous grasses and tunicated grasses. Tuberous grasses are such as *Phleum pratense*, var. *nodosum*, Gaud., and *Arrhenatherum avenaceum*, var. *nodosum* (*Avena nodosa*, L.), of which one or more of the basal internodes of the culm and shoots attain a tuberous development; while *Poa bulbosa*, L., represents a bulbous grass, since the bases of some of the sheaths of the leaves have increased in thickness and form a bulb very much like that of *Allium* †. He observes that these tuberous and bulbous forms only occur in countries with periods of dry seasons, and none have been observed in the moist parts of tropical regions.

It is very interesting to learn that the author does not consider these tubers and bulbs to be reservoirs of starch or sugar, as are the similar organs of Liliaceæ, Iridaceæ, &c., though being structurally homologous with these; but physiologically they are water-reservoirs, just as Dr. Volkens maintains with regard to the tuberous roots of species of *Erodium* in the deserts of Africa.

What is particularly to be noticed is that Hackel has shown that *Poa bulbosa*, on being cultivated in moist soil, almost lost the bulbous character, clearly proving therefore that these productions are the direct result of a dry environment.

These tuberous swellings on grasses are therefore clearly analogous with those on the roots of *Erodium*. Thus *E. hirtum* has globular, potato-like tubercles; *E. Hussoni*, finger-shaped; and long spindle-like roots occur in *E. glaucophyllum*.

They all contain a storage-tissue protected externally by a strong, many-layered cortical coating. Their position being between the absorbing root-apices and the foliar transpiring surfaces, they act as reservoirs and regulate the supply of water.

Bulbs of species of *Allium*, as *A. Crameri*, &c., are similarly adapted to the desert, storing water within the inner scales, whilst the outermost series become almost woody in texture, as a protection against the hot sand in which they lie.

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* "Ueber einige Eigenthuemlichkeiten der Graeser trockener Klimate," Verhandlungen der k. k. zool.-botan. Gesellsch. Wien, Jahrgang 1890, p. 125.

† Dr. Aitchison observed *Poa bulbosa* to be "the most common grass covering the great plains in Beluchistan" (*l. c.* p. 432) [*supra*, p. 221].

The cortex of roots acts as a storage-tissue in many plants, as in *Gypsophila Rokejeka*, and grasses, such as species of *Danthonia*, while the axis in both is densely woody.

A cause may be suggested for the development of the hypertrophied condition of the cortex and medulla of roots, which act as water-storage tissues, in the excessive heat which the sand surrounding the roots acquires from the sun. In the hottest months and hours of the day, the temperature may rise to about 130° F. (*Volkens*).

Now M. E. Prillieux * has shown experimentally how an abnormal excess of heat in the soil affects the roots of beans, &c., in a precisely analogous manner, by enlarging the cells of the cortex and pith. While, however, in this latter case the distention of the parenchymatous tissue is, of course, abnormal and pathological, in the desert plants it has become a characteristic important and hereditary feature.

M. Battandier also calls attention to the fact that there are plants in which certain buds swell into tubercles capable of enduring the dry season, while the rest of the plant perishes; such are *Saxifraga globulifera* and *Sedum amplexicaule.* In Malta there are several species of *Ranunculus*, such as *R. bullatus*, which produce "root-tubercles," which are thus enabled to survive the parching summer and can live therefore on the most exposed surfaces round the fortifications of Valetta. *Romulea Bulbocodium* and *Iris Sisyrhynchium* are similarly enabled to live and abound in barren rocky grounds of Malta. This island has also fifteen species of *Allium*, nine of *Ophrys*, and eight of *Orchis*, as well as many other bulbous plants, which can thus survive the intense summer heat to which they are subjected; annuals being in a decided minority except as weeds of cultivation.

From M. Hackel's observations on the tuberous processes in grasses which are formed in dry soil and disappear elsewhere, we, at least, have a strong suspicion, if nothing more, that all such structures are the outcome of the environment itself. This is also the conclusion of Mr. Scott Elliot, who notices how numerous are bulbous and tuberous plants in the Karoo of S. Africa. He says :—"Many orders have developed bulbs which usually show no trace of them; *e. g.* the whole section *Hoarea* of *Pelargonium* is bulbous." This feature he attributes to the "direct influence of the climate"[*].

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* "Altérations produites dans les plantes par la culture dans un Sol surchauffé," Ann. des Sci. Nat. sér. 6, t. x. 1880, p. 347.

Finally, with regard to the origin of water-storage tissues generally, I would suggest it to be primarily due to the accumulation of water within the plant in consequence of the arrest of transpiration. This latter function is impeded, in turn, by the formation of a thick and often waxy cuticle and a dense clothing of hair, as well as by the secretion of substances (such as tannin, gum, mucilage, resinous matter, salts, &c.) which thicken the water and so render it less capable of vaporization. But all these features, which thus bring about the very best structures to enable the plants to survive the injurious effects of the climate, are simply the direct outcome of the excessive heat and light coupled with the deficiency of water in the desert.

XII. *Secretions.*

These are of various kinds and appear to play an important part in arresting a loss of water. Thus, tannin is abundant in some desert plants, betraying itself by a yellowish appearance in the epidermal cells (*Monsonia*, *Erodium*, *Astragalus*, *Tamarix*, *Linaria*, *Centaurea*, &c.), as well as, of course, by the agency of iron salts. Dr. Volkens alludes to Warming's suggestion that tannin, in connection with the hygroscopical capacity of acids, would afford a protection against desiccation[†]. In alluding to this supposed use of tannin, it may be mentioned that Sachs regards it as a waste product in metabolism[‡], though fungi when attacking oak-wood appear to consume it[§].

On the other hand, Mr. S. Le M. Moore remarks that "tannic acid may have a more general relation to the turgescence of cells. Moreover, tannin is most likely used up in the lignification of the cell-wall"[‖]. As lignification is a prominent feature of desert plants, there may be perhaps more than a mere accidental coincidence.

Another kind of secretion is that of strong scented ethereal oils, glandular hairs being a common feature on desert plants. Species of *Artemisia* are characteristic plants of the deserts of

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[*] "Notes on the Regional Distribution of the Cape Flora," Trans. Bot. Soc. Edinb. 1891, p. 241.

[†] Zur Flora der aegyptisch-arab. Wüste, Skizze, p. 14.

[‡] Physiology, &c., p. 328.

[§] *Op. cit.* p. 388.

[‖] Journ. Linn. Soc., Bot. xxvii. p. 538.

Africa and Beluchistan; *Pulicaria arabica* has a particularly powerful odour. Since Dr. Tyndall has shown how minute quantities of such oils diffused through the air are capable of arresting radiant heat, it has been suggested that this is one of the many resources to which desert plants appeal in order to reduce the ill-effects of the heated atmosphere which surrounds them; and just as the presence and quantity of opium, hasheesh, aconitine, &c. secreted by plants varies greatly with the climate, so it is reasonable, in the absence of strict investigations, to assume that these oils are in an excess through the intense heat and other conditions of the climate of deserts.

Another of the more interesting secretions may be here mentioned, viz., of certain mineral salts, which by their hygrometric properties enable the plants to absorb dew from the air during the hotter months and thus transmit it to the tissues within. *Reaumuria hirtella*, species of *Tamarix*, *Frankenia pulverulenta*, species of *Statice* * and *Cressa* are the more remarkable instances. The first-named plant having developed its new foliage in early spring, when water is comparatively copious, the leaves in the early mornings appear covered with dew-like drops, no doubt due to root-pressure. As the sun mounts the water evaporates, and the plant is now covered with a dust-like secretion of chlorides of sodium, of calcium, and of magnesium; the two latter being of less proportion than the first. There are special, two-celled glands which secrete these salts. Later on, after the rainy period is over, these excessively hygrometric salts absorb dew, which is transmitted to the plant, and thus enable it to retain its bright green character all through the hot season †. In a similar manner a large number of very lofty *Tamarix* trees

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* See Mr. J. Wilson's paper on "Mucilage and other Glands of the *Plumbagineæ*," Ann. of Bot. iv. 1890, p. 231.

† I had a curious experience with this plant when drying it in a press for my herbarium. Placing freshly gathered specimens in the usual way between drying-papers, I proceeded to change them after three days. To my surprise I found the sheets perfectly saturated where the specimens were lying. They themselves were covered with dew-like drops, although under strong pressure. The salts had in fact rapidly drawn out the moisture from within the plant. After fresh papers were supplied the plant dried quickly.

There are some peculiarities in the anatomy of the leaf of *Reaumuria* which Dr. Volkens does not allude to, though he has figured the two-celled salt-glands, &c. One is the remarkable forms the "tracheides" of the leaves assume. Instead of being more or less straight tubes, they bulge into bag-like processes of three or four sides, or else assume various irregular shapes. They are thick-grow outside Cairo, but not quite on the desert. They never receive any water by artificial irrigation whatever, yet are in a very flourishing condition.

Halophytic plants, and others yielding ethereal oils, though not uncommon in the Egyptian deserts, in consequence of the general presence of salts in the sand, are of course especially characteristic of more saline areas, as of the Asiatic steppes. These extensive regions agree with the more Southern deserts in excessive aridity and heat; and consequently we find the same characteristic features in the plants of both alike, such as the production of spines, hairy epidermis, saline sap, and the secretion of ethereal oils. The *Chenopodiaceæ* are especially characteristic of both regions, the salts of soda imbibed by the roots and retained within the plant rendering the water less easy of evaporation.

Similarly there is a great secretion of ethereal oil in consequence of intense heat. Thus Grisebach observes that Arabia is on this account distinguished by its aromatic and resinous plants, of which several are equally indigenous in the steppes of the East*. While, however, these environmental conditions are the direct causes of the secretion of the oils, these latter, in their turn, aid in checking the loss of water. Thus Grisebach observes:—"Les huiles éthérées paraissent également agir d'une manière restrictive à l'égard de la dépense de la vapeur aqueuse, lorsque les organes de végétation sont richement pourvus de ces éléments aromatiques. L'huile s'évapore plus facilement que l'eau, et entoure chaque feuille d'une atmosphère imprégnée de vapeurs odoriférantes. On sait que les vapeurs de substances différentes restent indépendantes les unes des autres dans un espace qui en est saturé, mais il n'en est pas de même lorsqu'elles sont dégagées avec rapidité des liquides, dans des conditions où il ne peut être question de saturation. Sans doute, cette rapidité est retardée en présence d'une autre vapeur susceptible de se produire plus aisément. C'est l'huile éthérée seule que la

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walled, but provided with numerous small transverse slits. They suggest the idea that they are means of temporarily storing water until it is required to be transmitted elsewhere; and would seem to support M. Vesque's view of the use of vessels, or rather tracheides, as "réservoirs vasiformes." *Op. cit.* p. 38 [*supra*, p. 227].

* Vég. du Globe, ii. p. 129.

plante rejette comme une substance d'évacuation, tandis qu'elle doit retenir autant que possible l'eau de sa sève, lorsqu'il s'agit de prolonger la durée de ces fonctions vitales. Un rôle de certaine importance pourrait également revenir au phénomène de réfrigération produit par l'évaporation, au moment du passage rapide des huiles éthérées à l'état de vapeur, phénomène qui réagit contre la température communiquée par l'insolation aux feuilles, dont le degré de chaleur détermine aussi la marche de l'évaporation" *.

Mount Sinai appears to show like characteristic features of desert plants to a considerable height, viz. 7035 ft.; for Mr. R. M. Redhead, in some notes upon the flora, remarks †:—"During our ascent of Gebel Mûsa, followed by that of Ras-es-Sâfsafeh, two points especially struck me,—first the great preponderance of scented and especially Labiate plants; and, secondly, the very woolly, tomentose character of those not labiated." He also speaks of "a very fragrant *Tanacetum* or *Artemisia* with pinnated downy leaves .... *Satureja montana* and *S. Juliana*, I think, have an odour greatly resembling the incense used by the Greek Church, and are gathered by the monks for some ecclesiastical purpose. *Salvia clandestina* has woolly pinnatifid leaves." This last mentioned species of *Salvia* is a most variable one, and has given rise to much discussion and nomenclature. If, however, the effect of the environment be kept in view, which causes the variations, I think the passage from the European *S. Verbenaca* with large flowers and glabrous leaves to the S. European and Desert forms will be probably found to be exemplified by a gradual reduction of the leaf so as to become more deeply indented or of the "coronipifolioid" type, by the glabrous surface passing through a pilose condition till it becomes tomentose as described by Mr. Redhead; while the flower, adapted to insects, runs through the usual degradations till it becomes cleistogamous. Bentham thus speaks of *S. controversa*, which *S. clandestina* connects with *S. Verbenaca* ‡:—"It appears that in the ordinary *clandestine* state of this plant the corolla is abortive, as frequently occurs in *S. Verbenaca* and *S. clandestina*, especially in their more southern stations."

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* Vég. du Globe, i. p. 628.

† "Notes on the Flora of the Desert of Sinai," Journ. Linn. Soc., Bot. ix. p. 208.

‡ Labiat. Gen. et Sp. p. 719.

XIII. *General Summary of Observations on Desert Plants.*

Very many additional instances might be given in illustration of the preceding observations, but enough has been stated to bear out the contention, first, that we are justified in concluding, from innumerable coincidences between *structure* and *environment*, that there is some common relation between them of cause and effect; secondly, that all parts of plants are subject to variations, and that while, on the one hand, they may be merely casual, accidental, transient, and of no classificatory value whatever, yet on the other they may become more and more persistent and characteristic, and thence hereditary; affording the systematist features which he may pronounce as varietal or specific, as the case may be. Lastly, seeing how by experimental evidence plants can lose or take on such characters according as they are grown away from or in the normal environment, with which they are associated, the *cumulative evidence* amounts practically to a demonstration that varietal and specific characters are solely acquired through the direct action of the environment.

XIV. *Self-fertilization of the Flowers of Desert Plants.*

In walking along the dry watercourses or "wadys" of the deserts around Cairo, one cannot fail to notice the almost entire absence of conspicuous flowers. This fact is correlated with the paucity of insects. On a closer inspection it is found that a great many, probably the large majority, of flowers are self-fertilizing, the process of pollination being often associated with certain degenerate conditions of the organs of the flowers, as compared with allies of other countries which are adapted to insect visitors.

In my paper on "Self-Fertilization"* I drew up a list of characters some one or more of which are to be found in numerous weeds of cultivation and other plants which are habitually autogamous. Several of these conditions are characteristic of the flowers of Desert plants as well as other special features not therein mentioned.

The general conclusion arrived at by a study of the flowers of the Desert is in complete accordance with those I have elsewhere given †; namely, that flowers which have been adapted to insects, and therefore endowed with conspicuous and brightly coloured, often irregular corollas, honey, and other details, have to a great degree lost these features by a degenerating process. For if those structures which are correlated with insects were originally brought into existence by these visitors themselves, as I have endeavoured to prove, and if they be not "kept up" by the constantly applied stimulus of their visits, then the protandry, so general in conspicuous flowers, gives way, homogamy follows, and self-fertilization or autogamy is the final result, coupled with numerous degradations in all the floral organs. There are certain orders and genera which are particularly well represented in the Deserts, and I propose selecting a few species as being specially interesting from the peculiarities of their flowers.

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* Trans. Linn. Soc. ser. II. Bot. i. (1879) p. 317 etc.

† 'Origin of Floral Structures,' Chaps. xxvi. and xxvii.

The first order to be mentioned is CRUCIFERÆ, represented by over thirty species. A very common plant and one of the largest is the prickly bush *Zilla myagroides*. Another common plant is *Diplotaxis Harra*. These two agree closely in the structure of their flowers. The former has small, dull, brownish-pink veined petals; the latter, small pale yellow flowers: in both they are about half an inch in length. The petals of these, as of others of the Cruciferæ and Caryophylleæ, are narrow wedge-shaped or clavate in outline*, never having the broad limb and slender claw of insect-visited cruciferous flowers, such as those of the Wallflower. The two orifices seen from above in the last-named flower are closed up in these Desert plants; while the anthers closely surround the stigma, which in *Diplotaxis* is globular, a form which I have shown to be characteristic of British and other self-fertilizing species (*e. g.* Shepherd's Purse and *Pringlea antiscorbutica* of Kerguelen's Island). There are no honey-secreting glands.

Summarizing the peculiarities of several other cruciferous plants, one may note that the flowers are always very small, the petals being narrow, often notched irregularly at the top (*Savignya*, Pl. XII. fig. 3). The colour of the corolla is often brownish pink above, sometimes passing into pale yellow below (*Malcolmia ægyptiaca*, *Zilla myagroides*, *Farsetia ægyptiaca*). The anthers are usually elongated, "linear-sagittate," and always either just above or closely applied to the stigmas (*Malcolmia ægyptiaca*, Pl. XII. fig. 4; *Farsetia ægyptiaca*). The filaments may be curved inwards, bringing the anthers into close contact with the stigmas (*Diplotaxis Harra*). The glands are more or less rudimentary and honeyless or wanting. The pistil may have the two stigmatic lobes adpressed (*Erucaria aleppica*, Pl. XII. fig. 5; *Matthiola livida, Malcolmia ægyptiaca*). This would seem to be the preliminary stage, before arriving at the globular condition which occurs in *Diplotaxis Harra*, &c., just as in our common Shepherd's Purse. The pollination takes place in half-opened flowers; and in all the cases which I have personally examined the pollen-tubes were abundantly inserted and undoubtedly issuing from the anthers in contact with the stigmas.

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* See Pl. XII. figs. 1, 2, 3, and 8.

RESEDACEÆ has six species of *Reseda, Ochradenus baccatus, Oligomeris subulata*, and the very common *Caylusea canescens*. This last has about 5 or 6 distinct carpels, which are in the rudimentary condition of being always open from stigma to base, resembling follicles which have burst completely down the ventral suture. There are numerous ovules grouped together forming a cluster at the base of the carpels (Pl. XII. fig. 7). The minute stigmas are completely surrounded by the numerous anthers and are pollinated by them. The pollen-tubes pass down the inner surface, finally issuing in a great bundle at the base, and then penetrate the inverted ovules. The genus *Reseda* is represented by very small-flowered scentless and self-fertilizing species, the unilateral subcircular disk being much reduced in size.

CARYOPHYLLEÆ.—Of this order, *Silene villosa* (Pl. XII. fig. 8) resembles the Cruciferæ in the form of the petals, being irregularly notched at the top and tapering from above downwards. They are also inconspicuously coloured. The anthers are situated just above the stigmas. *Gypsophila Rokejeka* is also a common plant of the northern part of the Eastern Desert. The flowers are only about one sixth of an inch in size.

PARONYCHIACEÆ is represented by twelve species. The flowers are extremely minute and more or less concealed by scarious stipules. They belong to the genera *Robbairea, Polycarpon* (our self-fertilizing *P. tetraphyllum* occurs throughout the cultivated areas), *Polycarpæa* (Pl. XII. fig. 9), *Paronychia*, &c.

TAMARICACEÆ has seven species. Their minute flowers have globular stigmas covered with pollen from the anthers surrounding them (*Tamarix mannifera*). In *Reaumuria hirtella* (Pl. XII. fig. 10) the anthers surround the stigmas in the manner common to many self-fertilizing flowers.

GERANIACEÆ has seven species of *Erodium* growing in the Desert; while the British autogamous species *Geranium dissectum*, *G. molle*, *Erodium moschatum* and *E. cicutarium* are common in the cultivated districts; *E. cicutarium* having also established itself in the Desert as well. In the one or two species of *Erodium* which I have had the opportunity of examining, as also of *Monsonia nivea*, the pollen-tubes were visible, the pollen having evidently escaped from the anthers which were crowding round the stigmas.

LEGUMINOSÆ.—Of this order the genus *Astragalus* is the most typical, being represented by fourteen species in the Deserts. The flowers of *A. bombycinus* (Pl. XII. figs. 13, 14) are about one inch in length; but in other species they are very minute, the stigmas in all cases being pollinated by the anthers of the same flower and often before the flower expands (e. g. *A. mareoticus*, *A. tribuloides*, and *A. Sieberi*, Pl. XII. fig. 15). In the larger flowers of *A. bombycinus*, in order to place the stigma in the midst of the anthers the long style is bent in the form of the letter **N** (Pl. XII. fig. 13), a feature which would seem to indicate that ancestrally the style was curved and elevated above the stamens as in the English Broom. A similar adaptation to self-fertilization occurs in *Cassia obovata* (Pl. XII. figs. 11, 12), one of the two species of this genus found in the Deserts. This has small, very conspicuous brownish flowers, half an inch in length. In this flower some of the anthers are very small, twisted, and appear to be abortive, others are elongated on excessively short filaments and stand erect around the ovary. The style is bent abruptly downwards at its base, having the stigmatic end upturned, so that the pollen can fall directly upon it. There is no true stigma but a "jagged edge" to the stylar orifice; a not dissimilar degradation is found in *Linaria Hælava* (Pl. XII. fig. 27) and *Pulicaria arabica* (Pl. XII. fig. 16) of the same Desert *.

UMBELLIFERÆ.—This order is only represented in the Deserts by one or two plants, of which *Pityranthus tortuosus* is perhaps the commonest. This plant has extremely minute flowers in small umbels. The anthers shed their pollen while still incurved over the stigmas.

COMPOSITÆ.—Several characteristic plants of this order are found in the Deserts. Many have very small capitula. Thus the head of *Ifloga spicata* is six tenths of an inch across; that of *Leontodon hispidulum* and of *Brocchia cinerea* being one quarter; while that of *Artemisia monosperma* is only one eighth of an inch. As the flowers of Compositæ are generally more or less fertilized by one another on the same head, a process practically equivalent to self-fertilization—which is also equally common—there is nothing surprising in finding Desert Compositæ setting seed without the aid of insects.

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* A somewhat similar structure occurs in the "monstrous" *Myosotis alpestris*, var. "*Victoria*," in cultivation, as described in the 'Journal of the Royal Horticultural Society,' vol. xvi. 1893, pp. xxv, xxvi.

One or two special points of degradation may be mentioned. In *Cotula anthemoides*, *Brocchia cinerea* (Pl. XII. fig. 20), and *Francœuria crispa* the customary quinary symmetry has become quaternary. In the first-named plant the outer florets have a very rudimentary corolla with a jagged border. In *Senecio ægyptiacus* (Pl. XII. fig. 18), *Francœuria crispa* (Pl. XII. fig. 19), *Ifloga spicata*, &c. the stigmas remain included within the anther-tube, just as occurs in the Common Groundsel; in *Senecio ægyptiacus* the two stigmas being situated quite at the bottom of the tube. In all the specimens examined the pollen was early shed and the stigmas matured early. *Artemisia monosperma* has almost microscopically minute florets, and, as might be anticipated, it is completely self-fertilizing, the stigmas being tufted (Pl. XII. fig. 17). This is the only genus of Compositæ the pollen of which, according to Mr. C. F. White's researches, is smooth; but I find that it is so also in *Centaurea ægyptiaca* (Pl. XII. fig. 22).

CAMPANULACEÆ.—*Wahlenbergia cervicina* is a small plant of a few inches in height, and cleistogamous (Pl. XII. fig. 23). On cutting the corolla vertically, the curled stigmas are seen to lie in the midst of the anthers, and are of course directly pollinated by them (Pl. XII. fig. 24). A species of *Campanula*, *C. sulphurea*, is found near the great petrified forest a few miles east of Cairo. The corolla is inclined to be funnel-shaped rather than campanulate (Pl. XII. fig. 25). It is of a pale yellow colour, about three quarters of an inch in length. The anthers shed their pollen early and fall down, as is usual in this genus; but the style and stigmas are remarkable in that the former has few collecting hairs (Pl. XII. fig. 26), except just below the stigmas; while these latter are quite mature and pollinated at an early stage.

BORAGINEÆ.—Of the genus *Heliotropium* four species, and of *Anchusa* three are found in the Deserts. The flowers are very small. Those of *H. luteum* are about one sixth of an inch in length, those of *Heliotropium Kunzei* and of *H. undulatum* being one eighth. The orifice of the corolla is nearly or quite closed up by the infolding at the throat, and some, if not all, of the anthers curve over the stigmatic ring*. *Lithospermum callosum*, *Arnebia linearis*, and *Anchusa hispida* have the globular stigma situated just below the anthers. In all these species I have seen the pollen-tubes entering the stigmas, the pollen being undoubtedly derived from the anthers surrounding them.

LABIATÆ.—Of this order the Egyptian Deserts contain fifteen species. They are mostly small-flowered; one only, *Salvia palæstina*, being large-flowered and evidently adapted to insects in the well-known manner; but this species is confined to the N.E. portion, and, judging by its limited distribution, it is probably a comparatively late arrival. Of genuinely self-fertilized species the following may be mentioned:—

Salvia lanigera (*S. controversa*) (Pl. XII. figs. 28, 29). Though the flowers of this plant are ringent and not at all cleistogamous, the stigmas curl back between the anther-cells, just as in the unopened flowers of *S. clandestina*. *S. ægyptiaca* has minute flowers, about half an inch in length, with the stigmas just below the anther-cell (Pl. XII. fig. 29). *Lavandula atriplicifolia* has a spike consisting of imbricated bracts from which very minute flowers protrude.

SCROPHULARIACEÆ.—This order is represented by ten species. *Linaria* has, of course, a flower adapted to insects, but the three species *L. fruticosa*, *L. deserti*, and *L. ægyptiaca* are very small-flowered; they set a profusion of pods, and, judging from dried specimens in the Kew herbarium, they have all the appearance of plants which are independent of insects.

CHENOPODIACEÆ.—The members of this order found in the Deserts are all wind- or self-fertilized, as is the case elsewhere. Characteristic Desert species are *Atriplex leucoclada*, *A. Halimus*, *Bassia mucronata*, *Traganum undatum*, *Salsola Pachoi*, *Anabasis articulata*, and *Cornulaca monacantha*. They all have very minute and inconspicuous flowers.

Of ENDOGENS the orders best represented in the Deserts are LILIACEÆ and GRAMINEÆ. Of the former *Gagea reticulata*, *Urginea undulata*, *Allium desertorum*, *A. Crameri*, and *Dipcadi erythræum* are found in the north part of the Eastern desert.

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* For a suggestion as to the origin of the anomalous position of the stigma in *Heliotropium*, as in *Vinca* &c., see 'Origin of Floral Structures,' p. 135.

Henslow

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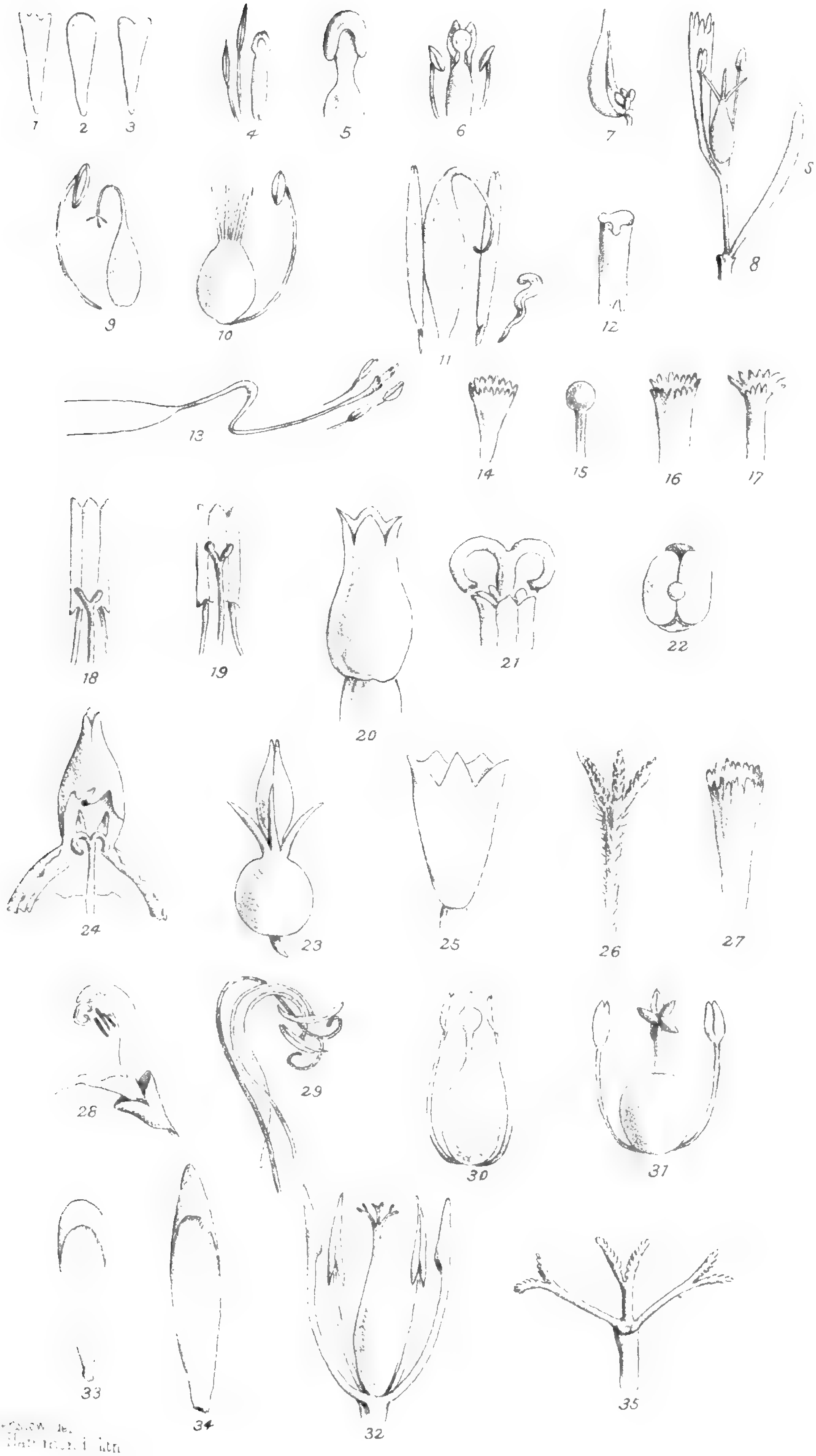
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ORIGIN OF PLANT STRUCTURES

The flowers are small and remain only partially open. *Allium Crameri* is one fifth of an inch long, *A. desertorum* one fourth, and *Dipcadi erythræum* one half. In all of these the anthers crowd round the stigmas and pollinate them in the half-opened flowers (Pl. XII. figs. 30, 31). *Dipcadi* is remarkable for having each stigma bifurcated, as in *Euphorbia* (Pl. XII. figs. 32–35); while *Allium desertorum* (Pl. XII. fig. 30) has a globular stigma.

EXPLANATION OF PLATE XII.

Fig. 1. Petal of *Erucaria aleppica.*
2. Petal of *Malcolmia ægyptiaca.*
3. Petal of *Savignya parviflora.*
4. Stamens and pistil of *Malcolmia ægyptiaca.*
5. Stigma of *Erucaria aleppica* with closely adpressed stigmatic lobes.
6. Stamens and pistil of *Savignya parviflora* with globular stigma.
7. Open carpel and naked ovules of *Caylusea canescens.*
8. Portion of flower of *Silene villosa* showing position of sepal (*s*), petal. stamens, and pistil on the gynophore.
9. Pistil and stamens of *Polycarpæa memphitica.*
10. Pistil and stamens of *Reaumuria hirtella.*
11. Pistil and stamens of *Cassia obovata.*
12. Hollow stigma of *Cassia obovata.*
13. Style and stigma of *Astragalus bombycinus.*
14. Stigma of *Astragalus bombycinus.*
15. Stigma of *Astragalus Sieberi.*
16. Hollow stigma of *Pulicaria arabica.*
17. Tufted stigma of *Artemisia monosperma.*
18. Anthers and stigmas of *Senecio ægyptiacus.*
19. Anthers and stigmas of *Francœuria crispa.*
20. Floret of *Brocchia cinerea.*
21. Stigmas of *Brocchia cinerea.*
22. Pollen-grain (smooth) of *Centaurea ægyptiaca.*
23. Cleistogamous flower of *Wahlenbergia cervicina.*
24. Corolla of same opened, showing the position of the curved stigmas and anthers.
25. Corolla of *Campanula sulphurea.*
26. Stigmas and style of same, nearly devoid of "collecting hairs."
27. Hollow stigma of *Linaria Hælava.*
28. Flower of *Salvia lanigera.*
29. Relative positions of anthers and stigmas in the flowers of *Salvia ægyptiaca* and of *S. lanigera.*
30. Three stamens and pistil of *Allium desertorum.*
31. Three stamens and pistil of *Allium Crameri.*
32. Portion of flower of *Dipcadi erythræum.*
33 & 34. Outer and inner perianth-leaves of same.
35. Bifurcating stigmas of same.

On some Freshwater Algæ from the West Indies.

By Wm. West, F.L.S., assisted by G. S. West.

[Read 1st February, 1894.]

(Plates XIII.–XVI.)

Through the kindness of Mr. George Murray, of the British Museum, I have been enabled to examine some Freshwater Algæ which were collected by Mr. W. R. Elliott on the islands of Dominica and St. Vincent—from the former in November and December 1892, and from the latter in May of the same year. The material was preserved in weak spirit, and has proved to be very interesting. The algæ were in numbered bottles; these numbers are used throughout the paper, as both material and slides, with corresponding numbers, can be consulted in the Museum.

The strictly aquatic species were mostly from warm or hot streams. Three of the gatherings were from mossy trees; these latter must have been very moist, as several species of Desmidieæ occurred amongst the various Cyanophyceæ which formed the greater part of this material. Some of the species were very abundant, e. g. *Symploca cuspidata*, n. sp.; there were others intermingled with these, either in small patches or solitary, and very sparingly.

Summary.

	Genera.	Species.	Varieties and Forms.
Confervaceæ	2	2	
Chroolepideæ	1	2	
Zygnemaceæ	1	1	1
Desmidiaceæ	3	6	1
Volvocineæ	1	1	
Protococcaceæ	2	2	
Nostocaceæ	1	2	
Scytonemaceæ	3	7	
Sirosiphoniaceæ	2	7	1
Oscillariaceæ	3	4	1
Chroococcaceæ	6	12	1
Diatomaceæ	8	14	1
	33	60	6

Of the above, 11 species and 4 varieties are new.

"Crass. fil." (as used in this paper) = the diameter of the sheath containing the trichomes.

"Crass. trich." = the diameter of the cells without the sheath.

Class CONFERVOIDEÆ ISOGAMÆ.

Ord. CONFERVACEÆ.

1. CONFERVA BOMBYCINA, *Ag.*, forma MINOR, *Wille.* (*Om Hvileceller hos Conferva*, p. 21, t. 1. figs. 36–40, t. 2. figs. 55, 56.)

Crass. fil. 6·5–7·5 μ.

Hab. In cold, warm, and hot streams, crater of Grande Soufrière, Dominica. Nos. 880, 883, 884, and 908.

2. RHIZOCLONIUM BERGGRENIANUM, *Hauck in Nordst. Freshw. Alg. of New Zeal. & Australia*, p. 17. Var. DOMINICENSE, nov. var. (Pl. XIV. figs. 17–24).

Var. filamentis dense intricatis, tenuior, articulis diametro 2–3plo longioribus; membrana cellularum 1 μ crassitudine.

Crass. cell. veget. 9–10 μ.

Hab. In hot stream in crater of Grande Soufrière, Dominica. No. 880.

In the more densely intricate portions almost every cell emitted a short lateral branch, usually consisting of one cell.

Ord. CHROOLEPIDEÆ.

3. TRENTEPOHLIA ODORATA, *Wittr.* (*Scand. Växter.* t. 4. p. 16.) [Chroolepus odoratum, *Ag. Syst. Alg.* p. 35.]

Crass. cell. veget. 12–20 μ; crass. zoogonidang. 33–37·5 μ.

T. zoogonidangiis lateralibus, interdum terminalibus, subglobosis, sessilibus (hinc inde pedicellatis).

Hab. On bark, Bow-wood Hills (1580 ft.), St. Vincent. (8–12–91.) No. 23.—On trees, Government House, St. Vincent, 900 ft. (10–12–91.) No. 27.

4. T. VILLOSA, *De Toni.* (*Syll. Alg.* i. p. 239.) [Chroolepus villosa, *Kuetz. Phyc. gener.* p. 284; *Species Algarum*, p. 428.]

Crass. cell. veget. 18–23 μ.

Hab. On rocks, Soufrière, Dominica. (2–7–92.) No. 20.

Class CONJUGATÆ.

Ord. ZYGNEMACEÆ.

5. ZYGNEMA (ZYGOGONIUM) PACHYDERMUM, nov. sp. (Pl. XIII. figs. 1–16.)

Z. cæspitibus intricatis; filis flexuosis (et interdum genuflexuosis) dense intricatis, hinc inde ramulis brevibus irregularibusque cellularum 2–6; cellulis vegetativis diametro 2–2½plo (sæpe 3plo) longioribus (rarius æqualibus); membrana cellularum crassa vel crassissima; zygosporis in tubo conjugationis brevi inter cellulas sitis, subglobosis, subellipsoideis, plerumque irregularibus (sæpe constrictis); membrana zygosporarum crassissima, irregulariter lamellosa; azygosporis globosis subglobosisque, zygosporis similibus sed membrana tenuiore.

Crass. cell. veget. 16–23 μ (usque ad 26 μ et plerumque 20 μ); crass. membr. cellularum 1·5–5·5 μ; long. zygosp. 25·5–33 μ (usque ad 40 μ); lat. zygosp. 19–26 μ (usque ad 30 μ); crass. membr. zygosp. 2·5–6·5 μ; diam. azygosp. 23–26 μ; crass. membr. azygosp. 1·9–3·8 μ.

Hab. In mud, warm stream, crater of Grande Soufrière, Dominica. No. 883; also in no. 908, and sparingly from no. 882.—This also occurred, without zygospores, on old wall, Roseau, Dominica. (1–8–92.) No. 473.

This species has a thick membrane which at first sight reminds one of a *Rhizoclonium* or a large species of *Conferva*, the somewhat irregular filaments with short branches resembling the former especially. The many examples of conjugation examined were all scalariform, the zygospores completely filling the short conjugating-tube, their variability being remarkable, Spores were seen (figs. 9–10) which were undoubtedly azygospores, and these were regular in shape. One example was noticed where the zygospore was double. The material was preserved in weak spirit; but the two chromatophores were in most examples distinct and in their normal position.

Var. CONFERVOIDES, nov. var. (Pl. XIV. figs. 1–6.)

Var. cellulis tenuior, diametro plerumque 1–1½plo (rarius 2½plo) longioribus.

Crass. cell. veget. 10–13 μ.

Hab. In mud, warm stream, crater of Grande Soufrière, Dominica. No. 883. Intermingled with the typical form, but not so abundant.

This variety has the cells of the filaments often somewhat doliform, and closely resembles a *Conferva*; it does not, however, break up in the peculiar manner of any species of *Conferva* (*vide* fig. 6). The binate chromatophores also put it out of this genus. Fig. 4 probably represents an attempt at conjugation.

Two cells are figured (fig. 5) which show an attempt at longitudinal division.

Ord. DESMIDIACEÆ.

6. **MESOTÆNIUM MICROCOCCUM**, *Kirchn.* (*Alg. Schles.* p. 134.) [Palmoglœa micrococca, *Kuetz. Tabulæ phycolog.* i. p. 20, t. 25. f. 5.]

Long. cell. 15·5–17·3 μ; lat. cell. 7·5–9 μ.

Hab. On trees among mosses, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.—On Bow-wood Hills (1580 ft.), St. Vincent. (8–12–91.) No. 23.

7. **M. CHLAMYDOSPORUM**, *De Bary.* (*Conj.* p. 75; *Cooke, Brit. Desm.* p. 47, pl. 18. f. 14; *West, Freshw. Alg. of W. Ireland in Journ. Linn. Soc.* vol. xxix. p. 131, pl. xxiv. f. 8.)

Long. cell. 19–23 μ; lat. cell. 12·5–14·5 μ.

Hab. On trees among mosses, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.

8. **TETMEMORUS LÆVIS**, *Ralfs.* (*Brit. Desm.* p. 147, t. 24. f. 2.)

Long. 57·5–65 μ; lat. 19–20 μ; lat. isthm. 17·5–18·5 μ.

Hab. In mud, warm stream, crater of Grande Soufrière, Dominica. No. 883.

9. **COSMARIUM PSEUDOPYRAMIDATUM**, *Lund.* (*Desm. Suec.* p. 41, t. 2. f. 18.)

Long. 46–48 μ; lat. 24–25 μ; lat. isthm. 9·5–12·5 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

***STENONOTUM**, *Nordst. in Wittr. et Nordst. Desm. et Œdog. in Ital. et Tyrol*, p. 32, t. xii. f. 8. Forma MINOR, *Racib.* (*Desmidya w podróży na oklo ziemi*, p. 4, t. i. f. 32). (Pl. XIV. fig. 25.)

Long. 36–36·5 μ; lat. 23–24 μ; lat. isthm. 6·5 μ; crass. 13·5 μ.

Hab. With the typical form, but much more abundant.

10. **C. OBLIQUUM**, *Nordst.* (*Bidrag till känned. om Sydligare*

Norges Desm. p. 23, t. 1. f. 8). Forma MINOR, *Nordst.* (*l. c.*). (Pl. XIII. fig. 17.)

Long. 14·5 μ; lat. 11·5 μ; lat. isthm. 6·5 μ; crass. 9·5 μ.

Hab. Amongst *Symploca cuspidata*, n. sp., on trees, summit of Trois Pitons (4500 ft.), Dominica. No. 904.

This interesting species seems to have a varied kind of habitat, occurring in small upland tarns and pools, on dripping subalpine rocks, and in the present instance on damp mossy trees.

11. COSMARIUM CUCURBITA, *Bréb.* (*Ralfs, Brit. Desm.* p. 108, t. 17. f. 7.)

Long. 40 μ; lat. 21 μ; lat. isthm. 19 μ.

Hab. On trees among mosses, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

Class CŒNOBIEÆ.

Ord. VOLVOCINEÆ.

12. EUDORINA STAGNALE, *Wolle.* (*Freshw. Alg. of U. S.* p. 160, pl. clii. figs. 11–21.)

Var. cellulis parvis et distantibus. (Pl. XVI. fig. 10.)

Diam. cell. 4·8–5·6 μ; diam. cœnob. 63 μ.

Hab. Amongst mosses on trees, with *Hapalosiphon intricatus*, n. sp., and *Symploca cuspidata*, n. sp., summit of Trois Pitons (4500 ft.), Dominica. No. 903.

Class PROTOCOCCOIDEÆ.

Ord. PROTOCOCCACEÆ (incl. *Palmellaceæ*).

13. UROCOCCUS INSIGNIS, *Kuetz.* [Chlorococcus macrococcus, *Rabh.*, et var. aureus, *Rabh. Fl. Europ. Alg.* ii. p. 33.]

Diam. cell. 23–31 μ; c. teg. 42 μ.

Hab. On mossy trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.

14. CERASTERIAS STAURASTROIDES, nov. sp. (Pl. XIV. fig. 16.)

C. quadriradiata e corpore distincto, radiis elongatis sensim attenuatis et minute granulatis, apice obtusis.

Diam. c. proc. 30–35 μ; diam. corpor. circ. 9–9·5 μ.

Hab. With *Scytonema javanicum*, Bornet, amongst mosses, on lime-trees, Shanford Estate, Dominica. No. 901.

The rough arms of this species remind one very forcibly of a small *Staurastrum*, and sufficiently characterize it.

Class PHYCOCHROMACEÆ.

Subclass NOSTOCHINEÆ.

Ord. NOSTOCACEÆ.

15. NOSTOC HUMIFUSUM, *Carm.* ex *Harvey in Hooker's Brit. Flora*, ii. p. 399. (*Kuetz. Species Algar.* p. 301; *Rabh. Fl. Europ. Alg.* ii. p. 183.)

Diam. cell. 2–3 μ; diam. heterocyst. 3·5 μ.

Hab. On lime-trees, Shanford Estate, Dominica. No. 901.—On trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

16. N. SPHÆRICUM, *Vaucher.* (*Cooke, Brit. Freshw. Alg.* p. 231, t. 91. ff. 8–11; *Bornet et Flahault, Révis. des Nostoch. Hétérocyst.* p. 208.)

Diam. cell. 3·8 μ; diam. heterocyst. 5–5·7 μ; diam. thall. usque ad 10 mm.

Hab. On damp wall of dam in Sharp's River, St. Vincent. No. 477.

Ord. SCYTONEMACEÆ.

17. MICROCHÆTE TENUISSIMA, nov. sp. (Pl. XIV. figs. 7–11.)

M. inter algas varias alias reperta; filis tenuissimis, subintricatis, contortis; vaginis hyalinis, achrois, amplis; articulis elongatis, diametro 5–9plo longioribus, articulis junioribus brevioribus (circiter diametro duplo longioribus) et crassioribus; heterocystis intercalaribus, subquadratis vel oblongis.

Crass. fil. 4·4–5·1 μ; crass. trich. 1–1·8 μ; crass. heterocyst. 2–2·4 μ; long. heterocyst. 3·5–6·5 μ.

Hab. Amongst *Symploca cuspidata*, n. sp., on trees, summit of Trois Pitons (4500 ft.), Dominica. No. 904.

18. SCYTONEMA JAVANICUM, *Bornet* (*in Bornet et Thuret, Notes Algologiques*, p. 148; *Bornet et Flah. Révis. des Nostoch. Hétérocyst.* p. 95). [Symphyosiphon javanicus, *Kuetz. Species Algarum*, p. 323; *Tabulæ phycolog.* ii. p. 13, t. 43. f. i.] (Pl. XIV. figs. 12–15.)

Crass. fil. 13-16 μ; crass. trich. 8·5–11 μ.

Hab. On lime-trees, Shanford Estate, Dominica. No. 901.—Anguilla, W. Indies. (23–3–92.) No. 70.—On the walls, Roseau, Dominica. (9–7–92.) No. 236.

The above agrees well with this species, the most notable difference being in the branches not being aggregate. The heterocysts vary from subquadrate to subrotund, and are rather numerous.

19. Scytonema amplum, nov. sp. (Pl. XVI. figs. 14–16.)

S. strato parvo, pannoso, 3–5 mm. lato, fusco; filis dense intricatis; pseudoramis sparsis plerumque geminatis sed interdum singulis, filo primario tenuioribus; vaginis amplissimis stratis parallelis formatis, in parte exteriore gelatinoso-achrois vel subluteolis, in parte interiore abrupte luteo-fuscis; trichomatibus angustis, luteo-viridibus, ad apicem pseudo-ramulorum crassioribus et articulis brevioribus; articulis diametro 3½–6plo (plerumque 4plo) longioribus; heterocystis oblongis, diametro 3–3½plo (rarius 2plo) longioribus.

Crass. fil. prim. 19–24 μ; crass. ramul. 13·5–16 μ; crass. trich. 3·5–4 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.—Growing about and upon the surface of *Symploca cuspidata*, n. sp.

The nearest species to this with regard to the comparative length and breadth of the cells is *S. ambiguum*, Kuetz., from which it differs in its much larger size, stouter habit, comparatively broader sheath, and in the more unfrequent branches. The branches are usually geminate though not unfrequently single, and they are always thinner than the primary filament. The trichomes at the apices of the branches become almost twice as thick, the cells becoming very much shorter. *S. myochrous*, Ag., is somewhat similar though larger, and has not such a comparatively broad sheath, and the latter is ocreate.

20. S. ambiguum, *Kuetz.* (*Species Algarum*, p. 894; *Tabulæ phycolog.* ii. p. 7, t. 26. f. ii.) (Pl. XV. figs. 11–15.)

Crass. fil. 9·5–11·5 μ; crass. trich. 2–2·5 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.—On the ground, mostly in old Diablotia holes, Morne Anglais (2300 ft.) (15–7–92.) No. 493. Amongst *Symploca*.

The figure given by Kuetzing (*l. c.*) is very indistinct; but the specimens agreed well with the description given by Bornet and Flahault (Révis. des Nostoc. Hétérocyst. p. 100), excepting that the filaments were a little thicker (9·5–11·5 μ against 6–9 μ). The trichomes were, however, the same. One of its chief characters is its long and narrow cells, which get shorter and thicker (up to 3·8 μ) towards the apices of the young branches; the sheath also becomes hyaline. The cells often appeared like the section of a biconcave lens, owing to the contraction produced by the dilute spirit in which the material was preserved.

21. SCYTONEMA FIGURATUM, *Agardh.* (*Syst. Algar.* p. 38.) [Scytonema calotrichoides, *Kuetz. Species Algarum*, p. 307; *Tabulæ phycolog.* ii. p. 6, t. 22. fig. ii.; *Rabh. Fl. Europ. Alg.* ii. p. 253.]

Crass. fil. 15·5–23 μ; crass. trich. 18–13·5 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.—On trees, summit of Trois Pitons (4500 feet), Dominica. Nos. 903 and 904.

22. SCYTONEMA, sp.

Crass. fil. 28–36 μ; crass. trich. 5–5·5 μ.

Hab. Amongst *S. javanicum*, Bornet, on lime-trees, Shanford Estate, Dominica. No. 901.

Only a small quantity of this was seen, which was insufficient for accurate determination. The characters were those of *S. densum*, Bornet, and it probably is a small variety of this species.

23. TOLYPOTHRIX TENUIS, *Kuetz.* (*Phycolog. gener.* p. 228; *Tabulæ phycolog.* ii. p. 9, t. 31. f. ii.) [T. pygmæa, *Kuetz.* T. flaccida, *De Bary.*]

Crass. fil. 7–7·7 μ; crass. trich. 5·7 μ; heterocyst. 7·7 × 5·7 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

Ord. SIROSIPHONIACEÆ.

24. HAPALOSIPHON INTRICATUS, nov. sp. (Pl. XV. figs. 16–28.)

H. cæspitibus parvis, æruginosis; filis densissime intricatis et variabilibus, adultis vaginis arctis distinctis (interdum paullo indistinctis) e cellulis singulis formatis, sparsim ramosis; ramis singulis unilateralibus flexuosis, filo primario subsimilibus, vaginatis vel evaginatis; cellulis variabilibus, diametro 1½–3plo longioribus, sæpe æqualibus et subrotundis, interdum elongatis: heterocystis intercalaribus, subquadratis vel oblongis (diametro 1–3plo longioribus).

Crass. fil. 4–7 μ; crass. heterocyst. 3·8–5·5 μ.

Hab. In little intricate tufts among the leaves of *Leucobryum*, on trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

The nearest species to this hitherto described is *H. laminosus*, Hansg. ["Ueber den Polymorph. der Alg.," Botan. Centralb. 1885, p. 48 (*cfr.* Bornet et Flah. Révis. des Nostoc. Hétérocyst. p. 55)], from which it differs, however, in not being calcified in any way, in being a little larger, in having its single and unfrequent branches of a similar thickness to the primary filaments without any attenuation, and in its peculiar habitat. The heterocysts are of the same breadth as that of the cells (or narrower), whilst those of *H. laminosus* are often broader. Like the latter, the threads are very variable, being sometimes similar to an *Anabæna*, sometimes like a *Lyngbya*, while at other times the cells are quite irregular and somewhat inflated. Some examples showed the rounded granulose bodies noted by Hansgirg in *H. laminosus* (Bemerkungen zur Systematik einiger Süsswasseralgen, p. 18). These bodies when fully formed appear to be thick-walled (figs. 23–28) and have a diameter of 6–13 μ.

The cell of the primary filament immediately under a branch always projects more or less into the sheath of the branch.

25. HAPALOSIPHON FLEXUOSUS, *Borzi.* (*Alghe d'acq. dolc. d. Papua, in Nuovo Notarisia*, Apr. 1892, p. 43.)

Crass. fil. 7·5–8·5 μ; crass. cell. 5·5–6 μ; long. cell. 4–4·5 μ.

Hab. In stream, Grande Soufrière, Dominica. No. 884.

26. H. ARBOREUS, nov. sp. (Pl. XV. figs. 1–3.)

H. inter alias algas repertus; filis primariis flexuosis, passim ramosis uno latere e cellulis singulis formatis, cellulis diametro 1–1½plo (rarius 2plo) longioribus, vagina arcta, tenui, et achroa; filis secundariis brevibus, crassitudine filis primariis similibus sed subtenuioribus, cellulis diametro subæqualibus; heterocystis quadrato-oblongis, intercalaribus.

Crass. fil. 7–10 μ; crass. cell. 7–9·5 μ; heterocyst. 6–9 μ × 9–11 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

The nearest species to this is *H. flexuosus*, Borzi (*l. c.*), from which it differs in not possessing flexuose intricate branches on every side; it is also a rather larger species, with cells often a little longer than broad and never depressed.

27. STIGONEMA HORMOIDES, *Bornet et Flah.* (*Révis. des Nostoc. Hétérocyst.* p. 69.) [Scytonema hormoides, *Kuetz.* Sirosiphon brevis, *Kuetz. Botan. Zeit.* 1847, p. 196; *Tabulæ phycolog.* ii.

p. 10, t. 34. f. ii. Sirosiphon hormoides, *Kuetz. Species Algar.* p. 316; *Tabulæ phycolog.* ii. p. 10, t. 34. f. iv.]

Crass. fil. 9–13 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904. Rather scarce.—On rocks, Roseau Valley (1000–2000 ft.), Dominica. (27–6–92.) No. 24.

Var. TENUE, nov. var. (Pl. XV. figs. 4–8.)

Var. minor, filis tenuioribus, 5·5–7 μ crassis.

Hab. With the typical form, but much more abundant. It was intermixed with *Symploca cuspidata*, n. sp., *Stigonema minuta*, Hass., *Scytonema ambigua*, Kuetz., &c.

28. STIGONEMA PANNIFORME, *Bornet et Flah.* (*Révis. des Nostoc. Hétérocyst.* p. 71.) [Scytonema panniformis, *Agardh*; Sirosiphon panniformis, *Kuetz.*]

Crass. fil. 23–26 μ.

Hab. With the preceding. Another gathering from the same locality had abundant hyphæ (an incipient lichen). No. 779. Crass. fil. 15–25 μ.

29. S. MINUTUM, *Hass.* (*Hist. of Brit. Freshw. Alg.* i. p. 230, t. 67. ff. 3–4.)

Crass. fil. 19–25 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.—On trees, summit of Trois Pitons (4500 ft.), Dominica, no. 903; and on lime-trees, Shanford Estate, Dominica, no. 901.

30. S. INFORME, *Kuetz.* (*Species Algar.* p. 319; *Tabulæ phycolog.* ii. p. 11, t. 38. f. iii.)

Crass. fil. 44–52 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.

Ord. OSCILLARIACEÆ.

31. SYMPLOCA CUSPIDATA, nov. sp. (Pl. XVI. figs. 1–7.)

S. bryophila, late expansa, griseo-lutea; fasciculis erectis, angustis subulatis, aggregatis (passim densis), 8–15 mm. altis, æruginescentibus; trichomatibus æruginеis, flexuoso-intricatis, in strato strictioribus, apicibus versus fasciculorum, 1–3 in lata vagina inclusis, sæpe interruptis, distincte articulatis; articulis diametro 2–4plo longioribus; vaginis amplis, achrois, pellucidis vel interdum stratis parallelis formatis, in ambitu sæpe subrugosis, apice angustioribus et sæpe ramosis.

Diam. trich. (s. vag.) 1·9–2·3 μ; crass. trich. c. vag. 13·5–25 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.

Var. LUTEOFUSCA, nov. var.

Var. ferruginea, strato denso, 1–2 mm. alto, fasciculis brevioribus, 4–6 mm. (interdum 10 mm.) altis, articulis crassioribus.

Crass. trich. 2·5–3·5 μ; crass. vag. 15–40 μ.

This variety also often has two, three, or more threads in one sheath.

Hab. On rocks, Roseau Valley (1000–2000 ft.), Dominica. (27–6–92.) No. 24.—On bark, windward road to lake (1000–2000 ft.), Dominica. (25–8–92.) Nos. 513 and 514.—Also on the ground, mostly in old Diablotia holes, Morne Anglais (2300 ft.). (15–7–92.) No. 493. Thicker and coarser sheath.

The specimens preserved in liquid strongly reminded one of *Sphagnum cuspidatum*; they occurred amongst mosses in penicillate tufts which were subæruginose towards the apices, the sheaths, but not the trichomes, here becoming narrower. Many of the sheaths in the stratum were without trichomes; and in consequence of this, and the broader sheaths at the base, the stratum was paler than the erect fasciculi.

32. LYNGBYA PENICILLATA, *Kuetz.* (*Botan. Zeit.* 1847, p. 194.) [Leibleinia penicillata, *Kuetz. Species Algar.*; *Tabulæ phycolog.* i. p. 46, t. 81. f. ii.]

Crass. fil. 3–3·5 μ.

Hab. On bed of stream in crater of Grande Soufrière, Dominica. No. 881.

33. L. SUBTILE, *West.* (*Alg. of the Eng. Lake Distr. in Journ. Roy. Micr. Soc.* Dec. 1892, p. 741, pl. x. f. 58.)

Crass. fil. 1·4 μ.

Hab. With the preceding.

34. PHORMIDIUM LYNGBYACEUM, *Kuetz.* (*Phycol. gener.* p. 194; *Tabulæ phycolog.* p. 33, t. 46. f. iii.; *Rabh. Fl. Europ. Alg.* ii. p. 124.)

Crass. fil. 3·5–4 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.—On old wall, Dominica. (1–8–92.) No. 473.

The cells were about as long as broad (sometimes a little longer).

35. PHORMIDIUM, sp.

Crass. fil. 1·2–1·5 μ.

Stratum dense, thin, and dark æruginous.

Hab. On damp wall, Roseau, Dominica. (5–9–92.) No. 546.

Ord. CHROOCOCCACEÆ.

36. CHROOCOCCUS MINOR, *Naeg.* (*Gattung. einzell. alg.* p. 47, t. 1 A. f. 4. *Rabh. Fl. Europ. Alg.* ii. p. 30.) [Protococcus minor, *Kuetz. Species Algar.* p. 198; *Tabulæ phycolog.* i. p. 3, t. 3.] (Pl. XVI. fig. 17.)

Diam. cell. 2·8–4 μ; diam. fam. 11·5–30 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.—On trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

Forma MINIMA. (Pl. XVI. fig. 18.)

Forma cellulis familiisque minoribus quam forma typica.

Diam. cell. s. teg. 1–1·9 μ; diam. fam. 10–23 μ.

Hab. Along with the type from the above-named localities, and also on lime-trees, Shanford Estate, Dominica. No. 901.

37. C. COHÆRENS, *Naeg.* (*Rabh. Fl. Europ. Alg.* ii. p. 30.) [Pleurococcus cohærens, *Bréb.*, 1842. Protococcus cohærens, *Kuetz.*]

Diam. cell. 3·8–6·5 μ (usque ad 7·5 μ); diam. fam. 30–173 μ.

Hab. Amongst other algæ on trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

This usually occurred in small families, but occasionally in very large ones, and now and then in solitary examples.

38. C. TURGIDUS, *Naeg.* (*Gatt. einzell. Alg.* p. 46. *Rabh. Fl. Europ. Alg.* ii. p. 32.) [Protococcus turgidus, *Kuetz. Tabulæ phycolog.* i. p. 5, t. 5. f. i.]

Diam. cell. s. teg. 7·5–10·5 μ, c. teg. 21–23 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

A rather small form.

39. C. SCHIZODERMATICUS, *West.* (*Alg. of the Eng. Lake Distr. in Journ. Roy. Micr. Soc.* Dec. 1892, p. 742, pl. x. ff. 61–63.) (Pl. XVI. fig. 19.)

Diam. cell. s. teg. 11·5–13 μ; diam. c. teg. 23–28 μ.

Hab. With the preceding species, but much more abundant.

40. **GLŒOCAPSA MURALIS**, *Kuetz.* (*Tabulæ phycolog.* i. t. 21. f. i.; *Rabh. Fl. Europ. Alg.* ii. p. 36.)

Long. cell. s. teg. 5·5–7·5 μ; lat. cell. s. teg. 2·5–3 μ; diam. fam. 19–25 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

The cells were longer in relation to their breadth than those figured by Kuetzing (*l. c.*).

41. **G. GIGAS**, nov. sp. (Pl. XVI. figs. 11–13.)

G. familiis solitariis vel subaggregatis; cellulis magnis, subglobosis vel oblongis, 4–36 in familiis subglobosis consociatis, membrana cellularum læva vel subtiliter granulata (vide fig. 11), cytioplasmate ærugineo et granuloso; tegumentis subglobosis, ad exteriorem duris sæpe subrugosis, luteo-fuscescentis, lamellis extra cellulas indistinctis, paucis et pallide luteolis.

Diam. cell. s. teg. 9–15 μ (plerumque 11 μ); diam. fam. 44–115 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

This occurred amongst *Nostoc sphæricum*, Vauch., in no definite stratum; and it is sufficiently distinguished by its large cells and other characters.

42. **GLŒOCAPSA**, sp.

Crass. cell. s. teg. 2–3 μ. Nos. 23 and 24.

43. **GLŒOCAPSA**, sp.

Crass. cell. s. teg. 1·5 μ. No. 546.

44. **APHANOCAPSA ELACHISTA**, nov. sp. (Pl. XV. figs. 9, 10.)

A. tegumento minutissimo, subgloboso, firmo, gelatinoso non lamelloso, achroo; cellulis minutissimis, sphæricis, solitariis geminatisve, laxe dispositis; cytioplasmate homogeneo et æruginoso; tegumentis non aggregatis in thallo distincto.

Diam. cell. 1·5–1·8 μ (usque ad 2 μ); diam. teg. 26–38 μ.

Hab. On trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.—And in stream, Grande Soufrière, Dominica. No. 884.

This species seems characteristically distinct by reason of its minute cells in the very small globose colonies, which were scattered amongst other algæ.

45. **GLŒOTHECE LINEARIS**, *Naeg.* (*Gattung. einzell. Alg.* p. 58, t. 1 G. f. 2; *Rabh. Fl. Europ. Alg.* ii. p. 60.)

Long. cell. sine teg. 5·5–6·5 μ, c. teg. 13·5 μ; lat. cell. sine teg. 1·8 μ, c. teg. 9·5–10·5 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

Forma cellulis 5–6plo longius quam latius. (Pl. XIV. fig. 26.)

Long. cell. s. teg. 11·5–13·5 μ, c. teg. 21 μ; lat. cell. s. teg. 2–2·3 μ, c. teg. 11·5–12·5 μ.

Hab. With the typical form.

46. GLŒOTHECE LUNATUM, nov. sp. (Pl. XVI. fig. 9.)

G. cellulis 2–4 in familiis consociatis, subcrescentiformibus, 2plo longius quam latius, apicibus acutis; tegumentis universalibus, ovalibus vel ellipticis; cytioplasmate ærugineo et homogeneo.

Lat. cell. 2·5–2·7 μ; apicibus cellularum 4·8–5·7 μ inter se distantibus; famil. 32·5 × 19 μ.

Hab. With *Gl. linearis*, Naeg., but very scarce.

47. APHANOTHECE SAXICOLA, *Naeg.* (*L. c.* p. 59, t. 1 H. f. 2.)

Lat. cell. 1·4–1·8 μ.

Hab. In small masses of 70–120 μ in diameter, amongst mosses on trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904. Rather scarce.

48. A. MICROSCOPICA, *Naeg.* (*L. c.* t. 1 H. f. 1.)

Long. cell. 5·5–7·5 μ; lat. cell. 3·8–4·4 μ; diam. famil. 108–179 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.—Amongst *Symploca cuspidata*, n. sp., on trees, summit of Trois Pitons (4500 ft.), Dominica. No. 904.

49. TETRAPEDIA TRIGONA, nov. sp. (Pl. XVI. fig. 8.)

T. cellulæ triangulares, lateribus concavis, angulis subrotundatis; a latere visæ ellipticæ; cytioplasmate pallide ærugineo et homogeneo.

Lat. cell. 7·2 μ; crass. 3·6 μ.

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

Class DIATOMACEÆ.

50. EPITHEMIA WESTERMANNI, *Kuetz.* (*Pritch. Infus.* ed. 1861, p. 760, t. 4. f. 2.)

Hab. In stream, crater of Grande Soufrière, Dominica. Nos. 881 and 908.

51. Eunotia Arcus, *Ehrenb.* (*W. Sm. Brit. Diat.* ii. t. 33. f. 283.)

Hab. In stream, crater of Grande Soufrière, Dominica. No. 908.

52. E. gracilis, *Rabh.* (*Fl. Europ. Alg.* i. p. 72.) [Himantidium gracile, *Ehrnb.*, *W. Sm. Brit. Diat.* ii. p. 14, t. 33. f. 285.]

Hab. Amongst mosses, on trees, summit of Trois Pitons (4500 ft.), Dominica. No. 903.

53. Odontidium mutabile, *W. Sm.* (*Brit. Diat.* ii. p. 17, t. 34. f. 290.)

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

54. Desmogonium Rabenhorstianum, *Grun.* (*Diat. ins. Banka*, p. 6, t. i. f. 1; *De Toni, Sylloge Algar.* vol. ii. p. 680.)

Hab. Abundant in stream (hot and cold), crater of Grande Soufrière, Dominica. No. 908.

55. Nitzschia parvula, *W. Sm.* (*Brit. Diat.* i. p. 41, t. 13. f. 106.)

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

56. N. flexella, *Suring.* (*Alg. Japon.* p. 11, t. 1. f. 12.)

Long. 33–44 μ; lat. 3·8–4·8 μ.

Hab. In streams, Grande Soufrière, Dominica. Nos. 881 and 884.

57. N. linearis, *W. Sm.* (*Brit. Diat.* i. p. 39, t. 13. f. 110.)

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.—And in streams, Grande Soufrière, Dominica. Nos. 881 and 908.

58. N. minutissima, *W. Sm.* (*L. c.* p. 41, t. 13. f. 107.)

Hab. In stream, Grande Soufrière, Dominica. No. 884.

59. Navicula cryptocephala, *Kuetz.* (*W. Sm. l. c.* p. 53, t. 17, f. 155.)

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

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FRESHWATER ALGÆ OF WEST INDIES

60. **Navicula borealis,** *Kuetz.* [Pinnularia borealis, *Ehrenb.*, *W. Sm. Brit. Diat.* ii. p. 94; *Rabh. Fl. Europ. Alg.* i. p. 216.]

Hab. With the preceding species.

61. **N. mesolepta,** *Ehrenb.* [Pinnularia mesolepta, *W. Sm. Brit. Diat.* i. p. 58, t. 19. f. 182.]

Hab. On bed of stream in crater of Grande Soufrière, Dominica. No. 881.

62. **Frustulia rhomboides,** *De Toni.* (*Sylloge Algar.* vol. ii. p. 227.) [Navicula rhomboides, *Ehrenb.*, *W. Sm. Brit. Diat.* i. p. 46, t. 16. f. 129.]

Hab. In stream, crater of Grande Soufrière. No. 908.

Var. **saxonica,** *De Toni.* (*L. c.*) [Frustulia saxonica, *Rabh.* Navicula crassinervia, *Bréb. in W. Sm. Brit. Diat.* i. p. 47, t. 31. f. 271.]

Hab. In streams (cold, warm, and hot), crater of Grande Soufrière, Dominica. Nos. 883 and 908.—Also amongst mosses on trees, summit of Trois Pitons (4500 ft.), Dominica. Nos. 903 and 904.

63. **Gomphonema tenellum,** *Kuetz.* (*W. Sm. Brit. Diat.* i. p. 80, t. 29. f. 243.)

Hab. On damp wall of dam, Sharp's River, St. Vincent. No. 477.

EXPLANATION OF THE PLATES.

Plate XIII.

Figs. 1–4. *Zygnema* (§ *Zygogonium*) *pachydermum*, n. sp. Conjugated specimens, 520/1.

5–8. Ditto. Four zygospores, 520/1.

9, 10. Ditto. Two specimens, with azygospores, 520/1.

11–15. Ditto, sterile filaments; fig. 11, 520/1; figs. 12–15, filaments, showing short branches, 120/1.

Fig. 16. Ditto, showing conjugation between three filaments, 120/1.

Fig. 17. *Cosmarium obliquum*, Nordst., f. *minor*, Nordst., 520/1.

Plate XIV.

Figs. 1–6. *Zygnema pachydermum*, n. sp., var. *confervoides*, n. var. Figs. 1 & 2, filaments without cell-contents; fig. 3, filament with contents delineated; fig. 4, attempt at conjugation?; fig. 5, cells showing longitudinal division. Figs. 1–5, 520/1; fig. 6, 830/1.

7–11. *Microchæte tenuissima*, n. sp. 520/1.

12–15. *Scytonema javanicum*, Bornet. 520/1.

PLATE XIV. (*continued*).

Fig. 16. *Cerasterias staurastroides*, n. sp. 520/1.
Figs. 17–24. *Rhizoclonium Berggrenianum*, Hauck, var. *dominicense*, n. var. 520/1.
Fig. 25. *Cosmarium pseudopyramidatum*, Lund, * *stenonotum*, Nordst., f. *minor*, Racib. 520/1.
Fig. 26. *Glœothece linearis*, Naeg., forma. 520/1.

PLATE XV.

Figs. 1–3. *Hapalosiphon arboreus*, n. sp. 520/1.
4–8. *Stigonema hormoides*, Bornet et Flah., var. *tenue*, n. var. 520/1. *h*, heterocysts.
9–10. *Aphanocapsa elachista*, n. sp. 520/1.
11–15. *Scytonema ambiguum*, Kuetz. 520/1.
16–28. *Hapalosiphon intricatus*, n. sp. 520/1.

PLATE XVI.

Figs. 1–7. *Symploca cuspidata*, n. sp. Fig. 1, natural size; fig. 2, a very small portion of one of the erect fasciculi, 120/1; fig. 3, a specimen showing three trichomes in one sheath, 120/1; figs. 4 & 5, examples with two trichomes in one sheath, 520/1; figs. 6 & 7, the apices of two filaments, showing in fig. 6 a broad sheath at the apex, and in fig. 7 a narrow one, 520/1.
Fig. 8. *Tetrapedia trigona*, n. sp. 830/1.
9. *Glœothece lunatum*, n. sp. 520/1.
10. *Eudorina stagnale*, Wolle, var. 520/1.
Figs. 11–13. *Glœocapsa gigas*, n. sp. 520/1. Fig. 11, an example having the cells with finely granulate walls; fig. 12, one where the lamellæ round the cells are not visible.
14–16. *Scytonema amplum*, n. sp. 520/1.
Fig. 17. *Chroococcus minor*, Naeg. 520/1.
18. „ „ „ f. *minima*. 520/1.
19. „ *schizodermaticus*, West. 520/1.

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West.

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Notes upon Apospory in a Form of *Scolopendrium vulgare*, var. *crispum*, and a new Aposporous *Athyrium*; also an additional phase of Aposporous Development in *Lastrea pseudo-mas*, var. *cristata*. By CHARLES T. DRUERY, F.L.S.

[Read 7th December, 1893.]

(PLATE XVII.)

THE case of apospory which I have the honour of bringing before the Society this evening is an entirely new one, in so far as it is exhibited by a fresh and apparently most unlikely species, viz. *Scolopendrium vulgare*, the normal smooth-edged strap-shaped fronds of which seem to offer no outlet for apical apospory, displaying, as they do, not the slightest tendency towards the formation of the slender lateral projections with which the phenomenon is usually associated in its apical form.

It was on a special visit to Mr. T. Bolton of Warton, near Carnforth, in August last to inspect a new aposporous *Athyrium*, to which I will later refer, that I came across the case now under notice in the shape of a variety of *Scolopendrium vulgare*, known as *Scolopendrium* var. *crispum Drummondæ*, found many years ago by Miss Drummond near Falmouth. This is a very singular compound variety in which the fronds are very long and narrow, finely frilled, and bearing, in addition, broad flat digitate crests often 9 inches across. Another peculiar feature is that the midrib is deeply undulated several times perpendicularly to the plane of the frond, and finally the margins of the frills are deeply cut into long fimbriate projections.

Mr. Bolton kindly sent me a plant, and on its receipt I at once perceived that in many cases the apices of these projections were bifid and translucent, presenting all the features of incipient prothalli. I consequently cut off a number of these with a small portion of attached frond, and inserted them in sterilized soil so that the terminal points or bifurcations were in contact therewith. In a few days evident signs of growth were visible, and in a week or two distinct prothalli of more or less cordate form and of normal size were developed, twin prothalli resulting in some cases, each limb of the bifurcations having developed independently. Root-hairs, however, were very tardy in appearing, due probably to the fact that growth was sustained by absorption through the adherent portions of frond; later on, however, they appeared somewhat abundantly, though hardly in normal quantity. In some cases thick fleshy prothalli of irregular form were developed from quite blunt projections which, when laid down, showed no signs whatever of prothallic growth.

In October I sent several specimens of these prothalli to Prof. F. O. Bower at Glasgow; and upon one of these he found numerous archegonia, both old and new, but no antheridia. The fact of these being true prothalli was, however, thus fully established. Later, in November, I found both antheridia and archegonia in abundance on one of the largest prothalli in my culture, an abnormal feature of which was the production ot these organs in quantity on both upper and under surfaces in conjunction with root-hairs, which, however, predominated on the lower surface, as might have been expected. It remains, of course, an open question whether plants will be produced; but, from general robustness of growth, I have little doubt on this point.

I exhibit the plant under notice, upon which the fimbriate projections will be clearly seen, though, unless laid down as described, they have failed to develop more than quite incipient prothalli even in a close warm frame. I also exhibit the cultures, two in number, showing developed prothalli, and accompany my notes with sketch of a portion of frond, natural size, and enlarged drawings of material after culture.

This constitutes the fourth British species in which apospory has been shown to occur, viz. *Athyrium Filix-fœmina* var. *clarissima*, *Polystichum angulare* var. *pulcherrimum* (several forms), *Lastrea pseudo-mas* var. *cristata*, and *Scolopendrum vulgare* var. *crispum Drummondæ*.

The second exhibit consists of cultures of a new aposporous find ot *Athyrium Filix-fœmina* by Mr. T. Bolton, who showed some pinnæ at the meeting of the British Pteridological Society at Lancaster in August last. This had been found in the autumn of 1892 in that district; and on examining the portions of frond submitted, I was at once struck with its strong resemblance to that form of *Athyrium Filix-fœmina* upon which apospory was first discovered, and was found in North Devon. The peculiar slenderness and attenuation of all subdivisions and the general make of the two ferns were almost identical, though the second find is easily recognizable by most of the terminals being spiral. When the pinnæ were handed to me, they were accompanied by the remark that "the spores never seemed to ripen;"

and upon turning them over, the reason was obvious, since I immediately recognized the peculiarly woolly appearance of the sori indicative of apospory, the masses of incipient prothalli being in this case so large as to give in some places a suprasoriferous appearance to the frond. As Mr. Bolton very kindly provided me with material, I laid down several pinnæ with the excrescences next the soil, and under close culture actual development immediately began, so that in a week or two each sorus had produced a crowd of full-sized prothalli. Reporting progress to Dr. F. W. Stansfield, who had also received material, he wrote that in his case apical apospory was also appearing, *i. e.* prothalli were being developed from the apices independently of the sori. Examining my material, I found several apparent cases of this, which, however, on closer investigation, I found to be produced from small aborted sori situated so near the terminal point that the resulting prothalli seemed to spring therefrom. I therefore asked Dr. Stansfield to re-examine his material, with the result that in the majority of cases he found the appearance had been deceptive, but in some the apices themselves were certainly dilating. A little later I found an unmistakable instance of an apical prothallus, as can be seen by the culture I exhibit. Otherwise this case is identical with that of *Athyrium Filix-fœmina*, var. *clarissima*, Jones, except that the growths are much more redundant. I have named the fern therefore *Athyrium Filix-fœmina*, var. *clarissima*, Bolton.

It will be observed that in this case, as in all previous ones, the abnormality occurs on wild finds, and has not been induced by culture; and considering the ease with which the prothalli are produced when the pinnæ are brought into contact with the soil, and the immense advantage which they must derive from being firmly attached to the frond from the beginning instead of, as in the detached spore, being at the mercy of a thousand and one disturbing factors, it is curious that the specimens found are solitary crowns instead of clumps. This advantage, however, in the struggle for existence is far more than counterbalanced by the absence of scattering spores, which limits the variety strictly to its birthplace.

Finally, I exhibit young plants raised from the aposporous prothalli of *Lastrea pseudo-mas*, var. *cristata*, which I brought to the notice of this Society in November 1892. These are interesting as exemplifying exactly intermediate stages between the oophore and sporophore, the primary fronds in some cases consisting of erect prothalli borne on stalks, while in the case of the parent the primary frond had been eaten off when the plant came under notice, owing to a prothallus forming at the tip of the second frond and others subsequently on its edges and surface. This exhibit was therefore necessary to complete the case by supplying the missing step, which it does, I think, very satisfactorily.

EXPLANATION OF PLATE XVII.

Scolopendrium vulgare, var. *Drummondæ*.

Fig. 1. Fimbriate projection from edge of frond (much enlarged). *p*. Prothallus developed by culture on moist soil. *rh*. Root-hairs. *c*. Thick fleshy cushion.

Fig. 2. Portion of frond, natural size, showing fimbriate projections terminating in *pp*. incipient prothalli.

Figs. 3, 4, 5, 6. Prothalli (×4) developed after severance of fimbriate projections from frond and insertion in soil.

Contributions to the Natural History of the Flower.—Part II. Fertilization Methods of Various Flowers; Cleistogamy in *Salvia Verbenaca*. By J. C. WILLIS, M.A., late Frank Smart Student in Botany of Gonville and Caius College, Cambridge. (Communicated by FRANCIS DARWIN, F.R.S., F.L.S.)

[Read 15th February, 1894.]

(PLATES XVIII. & XIX.)

THIS paper comprises the results of observations upon various native and exotic plants. The plants whose methods of fertilization were studied belong to the genera *Brodiæa*, *Stanhopea*, *Pimelea*, *Cotyledon*, *Nemophila*, *Hydrolea*, *Ziziphora*. A study of cleistogamy was made upon *Salvia*. The observations are mostly of similar character to those detailed in the first paper of this series.

Since the publication of my former paper*, my attention has been called by Prof. Bessey to a paper by him† in which the movements of the stamens in *Claytonia virginica* are described: the description tallies with that of the author for *C. sibirica*, &c.

Robertson‡ has described the fertilization of *Ellisia Nyctelea*, L., which seems on the whole to resemble that of the less

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* Journ. Linn. Soc., Bot. vol. xxx. pp. 51–63.

† "Sensitive Stamens in *Portulaca*," Amer. Naturalist, vii. 1873, p. 464.

‡ "Flowers and Insects, X.," Bot. Gazette, xviii. 1893, p. 49.

Druery.

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APOSPORY IN SCOLOPENDRIUM VULGARE

conspicuous species of ***Phacelia***. ***Hydrolea*** and ***Nemophila*** being considered in this paper, we now know the fertilization of five genera of Hydrophyllaceæ, though not fully. Lastly, the fertilization of *Monarda fistulosa* was described by Dr. Ida Keller * a short time before the author's paper was read. Her description differs from the writer's in that the anthers appear to dehisce in the bud; but this is rather what might be expected in plants examined in November, when the light is feeble and the temperature low. No trace of this early dehiscence occurred in the plants examined by the author in summer.

FERTILIZATION METHODS.

1. *Brodiæa ixioides*, S. Wats.—This, the only species of the Californian subgenus *Calliprora*, was studied in the Botanic Garden, Cambridge, during August 1892 and June–July 1893. It is scarcely visited by insects in England, and requires further study in its native place to be fully understood. The yellow flowers are borne in loose umbels, about 8–16 flowers being open at one time. The six perianth-segments are united below into a funnel-shaped tube about 6 mm. deep and 5 mm. wide at the mouth; the total width of the limb is about 25 mm. (Pl. XVIII. fig. 1). Down the middle line of each segment on the outer side runs a dark brown line, which shows through the leaf and may act as a path-finder. The tip of the leaf is slightly swollen out vertically. Inserted on the perianth, at the mouth of the tube, are six stamens, three (inner) long, three short. The filament is broad and fleshy, ending in two horns, between which on the inner side is the introrse anther (fig. 2). The stamen is prolonged downwards into a fleshy ridge on the inner surface of the perianth-tube. The ovary is borne on a gynophore, and has a style with a capitate trilobed stigma (fig. 4); it bears three rows of hairs opposite the long stamens.

The most interesting feature of the flower is the structure of the filaments of the stamens. These have a glossy appearance to the naked eye. Under the microscope it is seen that the horns and filament are covered with long, sometimes twisted, cells (fig. 3), which are very turgid, especially in warm weather, and rupture on being slightly touched with any hard body. A drop of fluid escapes on rupture: it has a pleasant slightly sweetish taste, and is attractive to insects. The flowers swarm with *Meligethes* and *Thrips*, licking the stamens. Many Diptera also visit them for the same purpose. The ridge which continues the stamen inside the perianth-tube is also covered with cells like those described above. If a stamen be scratched all over with a needle, so much fluid exudes that it trickles down into the base of the flower, and may accumulate there to some depth. These peculiar cells develop early, and are found in quite small buds.

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* "The Phenomena of Fertilization in the Flowers of *Monarda fistulosa*," Proc. Acad. Nat. Sc. Philad., Dec. 27th, 1892, p. 452. See also the paper which precedes it, "Notes on *Monarda fistulosa*," by Meehan.

Shortly after the flower opens, the three short stamens dehisce and cover the stigma with pollen (fig. 1). Its papillæ, however, are at this period very short, and apparently not receptive. Of flowers left to themselves, a large number do not set seed. Afterwards the flower increases in size (*cf.* Pl. XVIII. figs. 1 and 4), but the ovary grows most rapidly till the stigma is level with the long stamens; its papillæ are now very long and fully developed. The mouth of the flower is narrow, and insects probing the tube for honey must touch both anthers and stigma. Self-fertilization does not regularly occur; but may happen, especially when the flower finally shrivels up. The only insect visitors observed were those mentioned above, which did not usually effect fertilization; and it is not altogether evident how the flower is regularly fertilized, as it is much easier for insects to get honey by biting the stamens than by probing the flower in the proper way.

The above-described fertilization method does not agree very closely with that of any of the hitherto described Liliaceæ. *Allium* resembles it in the protandry, and *Lloydia* and *Lilium* also approach it in some measure, especially the latter, whose nectary, inserted on the perianth, gives a possible clue to the peculiar mode of nectar-secretion, if such it can be called, in *Brodiæa*.

Stanhopea tigrina, Bateman.—The mode of pollination of *S. oculata* was studied by Darwin*; but he failed to fertilize the flowers on account of the narrowness of the stigmatic chamber, which prevented the entrance of the pollinia. *S. tigrina* flowered profusely in the Cambridge Botanic Garden during 1893, and Mr. Francis Darwin suggested to the author that it should be carefully studied. This has been done, and the insertion of the pollinia has been easily managed; but it was found impossible to completely understand the flower on account of the want of the insects that in its native place (Mexico) probably pollinate it. The hypothesis as to the mechanism of the flower advanced below is perhaps somewhat strange; though *Coryanthes*, a near relative of *Stanhopea*, is equally extraordinary in its mechanism. It may be hoped that some botanist visiting Mexico will study the flower there and complete its elucidation.

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* 'Fertilization of Orchids,' p. 171.

Stanhopea tigrina is an epiphytic orchid with enormous pendulous flowers *. In greenhouse specimens they emerge through the bottom of a hanging basket. If held out horizontally they are liable to break off by their own weight. The five perianth-leaves, other than the labellum, are reflexed from their point of insertion, and are very conspicuous, as seen from the side or from below. They are of a deep chocolate-red colour striped with pale lemon-yellow, and are of a slightly fleshy texture. The labellum and column hang downwards, making a curious cage (Pl. XVIII. fig. 5); they are very thick and fleshy, and are, in consequence, very rigid and elastic. As seen in side view the flower, taken as a whole, is about 16 cm. deep and 16 cm. wide across the perianth, but often even larger than this. The "cage" narrows towards the mouth, where the anther and stigmas are (fig. 5). The basal portion of the labellum or hypochil (*hyp*, fig. 5) forms a curious pocket-like organ, widest at its lower end and with its mouth facing the column. Between it and the latter are wide openings through which an insect can fly into the mouth of the cavity. The mouth is bounded by sharply marked ridges below and at the sides. The inner surface of the cavity is covered with stout hairs of a deep-red colour.

Below the bucket comes the middle portion of the labellum, which consists of a stout horizontal mass of tissue (*mes*, fig. 5), prolonged at the ends into two long bars (*f, f*) which run downwards from it, at first outwards then inwards: these form the sides of the cage. The distal part of the labellum is fastened to the middle part by a well-marked joint or thin line; but if it be bent at the joint, breakage occurs: the joint would appear thus to be merely a survival from jointed ancestors with more flexible labella. This part of the labellum is of a broad oval shape, with a deep groove in it near the apex; like the rest of the labellum, it is thick and fleshy. The colour of the labellum is a pinkish white, with spots of a chocolate colour.

The fourth side of the cage is formed by the column, a very rigid structure (see figs. 5–10). Its basal part is nearly cylindrical; further out it widens into lateral wings, narrowing towards the apex, where are two horns projecting beyond on either side of the anther (fig. 7). The further end of the column has a sharp keel-like ridge on its anterior (inner) face, and the margins of the lateral wings are also folded inwards: two gradually narrowing grooves are thus formed leading to the stigmatic cavity, whose entrance is a long horizontal slit about 1 mm. wide (fig. 7). The cavity turns downwards inside the column (fig. 10), making a sort of pit. From its base a strand of conducting parenchyma runs downwards through the column. Above the stigma is a sharp ridge (*e*, fig. 7) bearing the anther. There are two pollinia attached by short caudicles to a pedicel of moderate length (fig. 8), which in its turn is attached to the upper side of the saddle-like portion of the rostellum. This is hollow, and contains a quantity of a viscid substance which does not fill the cavity. It is continued into a long narrow projection (fig. 7) which runs downwards parallel to, and just clear of, the edge of the central ridge of the column. Each pollinium has a central hollow opening to the outside at its further end (fig. 9).

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* Figured in Bateman's 'Orchidaceæ of Mexico and Guatemala,' pl. 7. Also in Bot. Mag. t. 4197, and Bot. Reg. 1839, t. 1.

The labellum and column are, except at one or two points to be mentioned below, of a most extraordinary slipperiness. They feel to the touch as smooth as ice.

With this introduction, we may go on to consider the actual mode of fertilization. If a sharply pointed pencil be slid sideways down the column, it follows the crest of the central ridge, and the point goes under the projecting tongue of the rostellum, and then reaches the viscid matter in the saddle. Owing to the hollow shape of this latter, already described, only a small portion of the viscid matter touches the pencil; and as one goes on with the movement, the adhesion is not sufficiently firm, and the rostellum often springs back into place. Occasionally, however, the adhesion is firm; and it can always be made so by pressing the saddle against the pencil. In this case the pollinia are removed, leaving the empty anther still in position. The whole, *i. e.* tongue, saddle, pedicel, and pollinia, stand in much the same straight line. No movement appears to occur after removal. The appearance of the summit of the column after removal of the pollinia and of the anther is seen in fig. 10. There remains a small narrow portion of rostellum (*k* in fig. 10) projecting down the column.

If, now, we again slide the pollinia upon the pencil along the column, they slide with the utmost smoothness along its slippery surface; and presently, as they reach the central ridge, they go one on each side of it. The smooth grooves lead them up to the stigmatic slit in the most exact manner possible; but we find that they are *too broad to enter*. This is the chief difficulty that Darwin found in *Stanhopea oculata*: it has also been noticed by other writers. The author has unfortunately not had an opportunity of examining this species. In it, according to Darwin, the pollinia do not shrink on drying; but in the species under consideration they do shrink considerably. The slit (fig. 9) in the pollinium narrows by the moving together of its sides, and the width of the pollinium is thus reduced sufficiently to enable it to enter the stigma. This process takes from 12 to 24 hours, according to the dryness of the air. The delay thus caused will ensure cross-fertilization. If the experiment with the pencil be tried after this period, it is beautiful to see the manner in which the pollinia slide up to and into the stigma. As one moves the pencil on, the caudicles are stretched at right angles to the pollinia and presently break, leaving the latter buried in the stigmatic slit. Within a day or two the pollinia are sucked right into the cavity out of sight, and a sticky fluid exudes from the mouth.

The flower was found by experiment to be self-fertile (in Cambridge). Flowers fertilized from another plant set good seed, even when the pollinia were a week old. The flower itself lasts only three days, even when not fertilized, a somewhat unusual circumstance in these large and showy orchids.

We come now, finally, to the mode in which insects are attracted to the flower, and the way in which it is actually fertilized in nature. Unfortunately, as has already been explained, it has not been possible to study the plant in its native place; so that this part of the work must remain doubtful. The flower is very conspicuous from the side or from below, and possesses a very powerful vanilla-like odour, which gives a headache to a person sitting over it for any time, and renders our British bees almost incapable of walking if they are shut in with the flower for a couple of hours. The cage formed by the column and labellum hangs downwards, as already explained; and is extremely slippery inside and out except in a few spots, viz. the stalk portion of the column, the interior of the bucket (the slipperiness begins at the mouth of the bucket), and the back of the same. It was found, by experiments with hive- and humble-bees, that they were unable to climb up the slippery labellum.

This fact, taken together with the pendulous position of the flower and the arrangement of the viscid disc, renders it evident that the flower cannot be fertilized by entrance of insects at the mouth of the cage. This suggested that the removal, or insertion into the stigma, of the pollinia was effected by insects *sliding* down inside the cage. This idea was tested by enclosing the flower in a large glass bell-jar and putting a number of large humble-bees, such as *Bombus hortorum* and others, in with it. After vainly buzzing round the glass for some time, these began to visit the flower, and their actions were carefully watched. Sometimes they alighted on the petals and wandered about upon them; but others found their way into the bucket by flying straight through the large openings between it and the column, which appear as if specially constructed for this purpose. The bucket contains a great number of juicy hairs, which are probably nibbled by bees, as in other orchids; but our native bees did not seem to understand how to go to work. Presently, therefore, they tried to return by the way they came. They could not, however, fly straight out, as the opening of the bucket itself was too narrow for them to spread their wings. They, therefore, had to crawl out; and as soon as ever they crawled over the edge, they came upon the highly polished surface upon which they could get no grip. Sometimes they hung by their hind legs for a time; but usually they slipped down at once, slid down the cage and out at the mouth. It was quite ludicrous to see the way in which the bees "tobogganed" down inside the cage; they mostly fell upon the table before they realized what had happened.

These experiments seem to favour the "sliding" theory; but, unfortunately, the pollinia were never removed. The bees usually slid down with their backs to the column; and there is no projecting point on the back of a humble-bee, so that the projecting tongue (c in fig. 7) was never caught. A bee, such as the *Euglossa* mentioned by Darwin, whose tongue is carried under its body and projects over its back from behind, would very probably remove the pollinia. So also would any bee with any projection on its back. Another possible case would be a bee with a sharp-pointed abdomen falling tail first. Some of the humble-bees experimented on fell tail first, but were too stout to put the tail under the rostellum. The curious hollow shape of the viscid disc also points to the probable occurrence on the visiting insect of some rounded projection (say the tail) which will fit it.

When the flowers were placed in the open air on a warm day in August, they were visited by various Syrphidæ and by species of *Bombus* and *Apis*. From the general size of the parts and the absence of free honey, it would seem probable that the flower is adapted for large bees.

Another point that still requires explanation is that the viscid matter of the rostellum does not set at once, as is usually the case in orchids on exposure to air*, but takes from 12 to 24 hours to do so; hence, unless the pollinia are very firmly pressed on to start with, they are easily knocked off subsequently.

The smoothness of the labellum appears to be due to a very thick cuticle on its epidermal cells. This can be stripped off without difficulty in pieces an inch square.

The bucket portion of the labellum is lined with stout hairs; the cells of these and of the outer layers of the subjacent tissue have deep red-coloured cell-contents. They appear also to contain sugar (?).

Pimelea decussata, R. Br., var. *diosmæfolia*, Meisn. (in DeCandolle, Prod. xiv. p. 503).—The flower was studied upon a fine plant in the Cambridge Botanic Garden; when in bloom it is very conspicuous, every twig ending in a head of about forty pink-coloured flowers somewhat loosely arranged. The reddish-coloured perianth is tubular, 12 mm. long and 1 mm. wide at the mouth, with a spreading limb of four segments whose total width is about 7 mm. The anterior and posterior segments are usually bent slightly downwards (Pl. XIX. fig. 11). The tube is hairy outside; on the lower part the hairs are long and horizontal, on the upper part shorter and directed upwards. The two stamens are inserted on the throat, opposite to the anterior and posterior segments of the perianth; they project beyond the perianth, and the pollen is thus exposed freely, as in so many dry-climate plants. The ovary consists of one carpel with a lateral style and capitate stigma.

The flower has no scent; honey is secreted by four glands, two on the anterior, two on the posterior side of the base of the ovary. It is well protected from rain or short-tongued insects by the long perianth-tube.

When the flower opens we see the two stamens sticking out, somewhat diverging from one another, with open orange-coloured anthers (fig. 11); the style is still enclosed in the tube, and its stigmatic papillæ are very short. The stamens now move slowly outwards and downwards, and the style grows out until the stigma stands at the level formerly occupied by the anthers; its papillæ are now three or four times as long as in the earlier stage. The stamens now almost touch the perianth-lobes (fig. 12), and finally come to rest upon them (fig. 13).

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* It is of course always, to some extent, exposed to the air before the pollinia are removed at all.

It is scarcely possible for autogamy to occur, as stigma and anthers are never so placed that pollen can get from one to the other. Pollen may fall from one flower, however, to another upon the same head. Out of 77 flowers examined, only 13 had set seed.

Various Diptera (Syrphidæ and others) were observed visiting the flowers; most of them confined themselves to feeding on pollen, as their tongues were too short to reach the honey. The flower appears more suited to bees or the long-tongued flies, or Lepidoptera.

Cotyledon Umbilicus, Linn.—This is one of the few plants native in Britain whose floral biology has hitherto remained unknown. The plant has a tall raceme of inconspicuous scentless greenish-white flowers, pendent upon short stalks. The calyx is very small, the gamopetalous corolla tubular, about 10 mm. deep and 3 mm. in diameter (Pl. XIX. fig. 14). The stamens, ten in number, are inserted on the corolla near the mouth, those opposite to the petals being a little higher up than the others. This latter point is of some importance, as the flower is obdiplostemonous, and so has the stigmas opposite to the long stamens (fig. 15). The five carpels have each a large scale at the base, apparently, as in the rest of the order, secreting honey. This organ is reddish yellow in colour, and is visible, through the corolla, from outside, giving a reddish tinge to the base of the petals (*n*, fig. 14). The stamens dehisce when the flower opens, standing on a level with the stigmas, which are as yet not fully developed (figs. 15 and 16). There is a very small space separating the anthers from the stigmas. In consequence of the pendulous position of the flower (it hangs at an angle of about 40°–80° with the horizontal), the anthers of the long stamens are a trifle below the stigmas. Later on, the latter develop, growing outwards, as shown in fig. 17. This brings them extremely close to the anthers. Young flowers stand out more horizontally than old ones. An insect probing the flower for honey in the young stage will receive pollen upon its head or proboscis, and will probably place it upon the stigma in other flowers, the entrance to the honey being very narrow. In the later stage of the flower autogamy will almost certainly occur, whether it be visited by insects or not. The distance between anthers and stigmas is extremely small, and a very slight displacement, such as might be caused by an insect grasping the corolla, will bring them into contact with one another. In the final withering of the flower, the corolla collapses over the stigmas, and autogamy may occur then. Aphides are common in the flowers; one of them was observed in the act of producing autogamy. It became stuck to the stigma in climbing out of the flower, and in its struggles almost emptied the neighbouring anthers of their pollen, which it brought upon the sticky stigmas.

The pollen is smooth, but not, apparently, powdery, so that the mechanism cannot be compared with that of *Erica* or *Galanthus*. Although the flower is pendulous, the pollen is often wetted by rain getting in; the water collects in a large drop at the mouth of the corolla, and then gets inside very easily. After a heavy shower, many flowers were found full of water.

The flower is thus protandrous, with well-marked self-fertilization. All the flowers examined had set a full complement of seed. The only insect visitor observed beyond the Aphides above mentioned was *Thrips*, but only a few racemes could be watched, as there was but little material. Some stalks were found bearing male flowers only at the top of the raceme; these had small shrivelled carpels. The plant may thus be andromonœcious under certain circumstances. One plant bore, in the middle of the raceme, about twenty flowers with all their organs aborted except the calyx.

Hydrolea spinosa, Linn.—This plant belongs to the same family as *Phacelia* *, and its mechanism is somewhat similar. The flowers are in loose cymes, and azure blue in colour, with no perceptible scent. The stems, leaves, and calyces are covered with glandular hairs. The corolla is rotate-campanulate, 13 mm. across and 10 mm. in depth, the segments long, the tube short and wide. The five stamens are exserted, and bear versatile anthers with a large connective. Each lobe dehisces by a longitudinal slit, but does not at once turn completely inside out as in *Phacelia*. The pollen is brown. Honey is secreted by a disc below the ovary, and protected, as in *Phacelia*, by processes of the stamens. These are thick and fleshy, covered with stout papillæ, and block up almost all the space between the corolla and ovary (figs. 19, 20). The latter bears glandular hairs on its upper part, above the staminal processes (figs. 18 and 20), and ends in a bifid style, with terminal stigmas, which are very sticky. There are no conspicuous honey-guides.

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* Cf. *antea*, p. 53.

Although so conspicuous, the flower, at least in England, is excellently adapted to self-fertilization. The stamens are bent inwards, and are usually found touching the stigmas when the flower opens. Soon the styles bend outwards a little, carrying the stigmas just clear of the stamens, and giving a chance of cross-fertilization, and then finally the flower shrivels up, and in so doing almost always pollinates its own stigmas. Every flower sets seed, even in the absence of insects.

Nemophila maculata, Benth.—The only specimens available had been some time in cultivation, and therefore were not suitable for a study of the dichogamy, but the general natural history characters of the flower could easily be made out. The flower is very conspicuous, owing to the blue spots that terminate the white corolla-lobes; these are also veined with blue (honey-guides). The calyx is softly hairy. The stamens are included, with versatile anthers, which usually hang so as to dehisce extrorsely; they shorten and roll backwards on dehiscence. The ovary is hairy, rounded (not flattened as in *Phacelia*), and glandular; the style short, bifid, hairy, especially below, and glandular; the stigmas terminal. The corolla bears appendages like those of *Phacelia tanacetifolia**, which make a little tube leading to the honey, which is secreted by the disc below the ovary. At the mouth of the tube are several dark spots on the corolla, which may serve as path-finders. The honey is perhaps most easily obtained by probing these tubes, but is accessible, as in *Phacelia*, between the stamens and processes of the corolla, at the base of the flower.

The flower shows protandry very similar to that of *Phacelia divaricata*, and is visited chiefly by bees, to which and to long-tongued Syrphidæ it would appear to be best adapted. The stigma is not quite mature when the anthers dehisce, but soon reaches maturity. The flowers generally set seed, and probably often fertilize themselves (cf. *Phacelia divaricata*).

Nemophila thus resembles the other Hydrophyllaceæ in its general characters, approaching *Hydrophyllum* on the one hand and *Phacelia* on the other.

Ziziphora capitata, Linn.—This member of the Labiatæ bears very small inconspicuous flowers, and appears to fertilize itself regularly. The calyx is tubular, 8 mm. long, constricted at the middle; the corolla projects about 1–2 mm. beyond it, and opens to a width of 2 mm. across the two lips; the lower lip is 3 mm. wide. The conspicuousness is thus very small; the corolla is of a purplish red. The tube of the corolla is only ·4 mm. in diameter in its lower half, and about ·9 mm. above. At its mouth it is crossed by the filaments of the two anterior stamens (the posterior pair are aborted), which run up under the upper lip. The corolla is hairy outside and upon the lower lip, while lines of hairs continue down it, inside, from the insertion of the stamens. The anthers cohere at first like those of *Monarda*, and the style runs up behind them and curls down over and between them. The stigma is thus pollinated as soon as the anthers dehisce, and as it soon after shrivels up, there is scarcely any chance of a cross-fertilization taking place. Almost every flower examined had set seed, and most of them their full number. Fourteen flowers gave forty fruits altogether, or over 70 per cent. of the possible number.

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* Cf. *antè*, p. 54 and figs. 4, 5.

From the length of the tube and the colour, &c., the flower would seem to have been formerly adapted to bees or Syrphidæ, but now it apparently receives few or no visits and fertilizes itself regularly.

Cleistogamy.

Salvia Verbenaca, Linn.—This species exists under two forms, the normal and the variety *clandestina*. Only the normal form occurs in Cambridgeshire, according to Babington *. The species is, however, a very variable one †. The author has carefully observed many plants growing at Grantchester, Ditton, and other places near Cambridge, and has also cultivated specimens (from wild seed), which behaved similarly to the wild ones. The plants bear a great variety of patterns of flower, the bulk of which, however, during 1892–93 have been, not the normal open flowers, but rather cleistogamous, with reduced corollas. Various types are shown in the figures (Pl. XIX. figs. 21–25). The vast majority of the flowers were of the type shown in fig. 21, the corolla not at all or hardly visible at the mouth of the calyx, and completely closed. At the time of fertilization the corolla was about 2 mm. long, and 1⅓ mm. wide, blue at the further end (fig. 22). The position of the essential organs is shown in fig. 23, the style being curled round the anthers in the lower lip, where it is fertilized. Nearly every flower set a full complement of fertile seed. During the early part of June 1893 all the flowers were of this type. Towards the end of the month appeared flowers with larger corollas, as much as 5 or 6 mm. long; these were slightly open at the mouth, but the style still ran into the lower lip and was fertilized there. Soon after, flowers like fig. 24 were found, with the style projecting at the mouth, but it was found to have been pollinated in the bud. Finally a few flowers were observed like that shown in fig. 25, with the corolla fairly large, its mouth wide open, and the lever mechanism in good working order. These flowers were fully capable of insect-fertilization, and did not pollinate themselves in the bud. No insects were seen to visit them, however, which is not surprising when we consider their inconspicuousness.

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* 'Flora of Cambridgeshire,' p. 176.

† Timbal-Lagrave, "Recherches sur les variations que présentent quelques plantes communes dans le département de la Haute-Garonne." Mém. Acad. Sci. Toulouse (Reprint, not dated).

Later on in the season (August onwards) the plant bore the cleistogamic flowers again, without any intermixture of open ones. On the whole, as the season advanced, the corollas became steadily smaller, till in November they were once more only about 2 mm. long; the flowers, however, were still fully fertile. One flower was noticed with the stamens completely aborted.

It would thus appear that the forms of flower on *Salvia Verbenaca* vary considerably with the season of the year at which they are examined, and this fact must therefore be taken into account in considering the forms and varieties of the species.

From a natural history point of view, the facts described above are of some interest as throwing light upon the origin of cleistogamy. The plants bore flowers with very reduced corollas at the beginning and end of their flowering season, and the larger forms chiefly in June and July. It would thus seem probable that the cause of the variation in size of the corolla is either light or temperature, or both together, but the observations made gave no evidence as to which of the two was the important factor. In many plants with cleistogamic flowers, e. g. *Lamium amplexicaule*, these flowers appear at a season when the light and temperature are lower than at the time of appearance of the normal flowers. In others, e.g. *Viola*, the cleistogamic flowers appear in the brighter and warmer period, but are found usually to be on the shaded parts of the plant. The first-named facts leave it undecided whether light or temperature be the main factor; the latter seem to point to reduced light as the main cause of reduction of the corolla. This has been in a large measure proved by the recent experiments of Vöchting*, upon the action of light of various degrees of intensity upon the flowers of plants which had a tendency to cleistogamy. At the same time, this does not seem to explain everything; for instance, the fact observed many times on *Salvia*, that normal flowers and cleistogamic flowers occur side by side at the same node. This phenomenon the author is inclined to regard as an effect of varying temperature: the flowers had not usually opened simultaneously, and so had been exposed to different conditions of temperature at corresponding periods of growth. This would cause in them varying degrees of protandry (according to the hypothesis of the origin of dichogamy proposed by Meehan and adopted by the writer†). Those that were thus caused to become very protandrous would be fertilized in the bud, and the corolla would probably wither without ever opening. A slightly less degree of protandry would give the type of fig. 24 and a lesser still would give the normal flower. This reasoning of course is not conclusive, as it may be applied to the action of light instead of heat; but we have a certain amount of evidence in favour of the view that dichogamy is dependent on temperature, and it therefore does not seem a very forced view, especially as the temperature conditions are perhaps more variable than those of light during a short period.

Viola tricolor, Linn.—Vöchting's experiments bring out, among other interesting facts, that in a zygomorphic flower the upper lip becomes reduced, under the action of diminished light, more rapidly than the lower. Some specimens of *Viola tricolor*, var. *arvensis*, gathered on Dec. 9, 1893, illustrate this reduction very well. The whole corolla is small in comparison with the calyx, but the upper lip is far more reduced than the lower (fig. 26).

Finally, the author wishes to thank Messrs. F. Darwin, R. I. Lynch, and I. H. Burkill for much valuable advice and assistance kindly rendered.

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* "Ueber den Einfluss d. Lichts auf die Gestaltung und Anlage der Blüthen." Pringsheim's Jahrb. xxv. 1893, pp. 149–208.

† "On Gynodiœcism, with a preliminary note on the origin of this and similar phenomena." Proc. Camb. Phil. Soc. viii. 1893, pt. iii.

EXPLANATION OF THE PLATES.

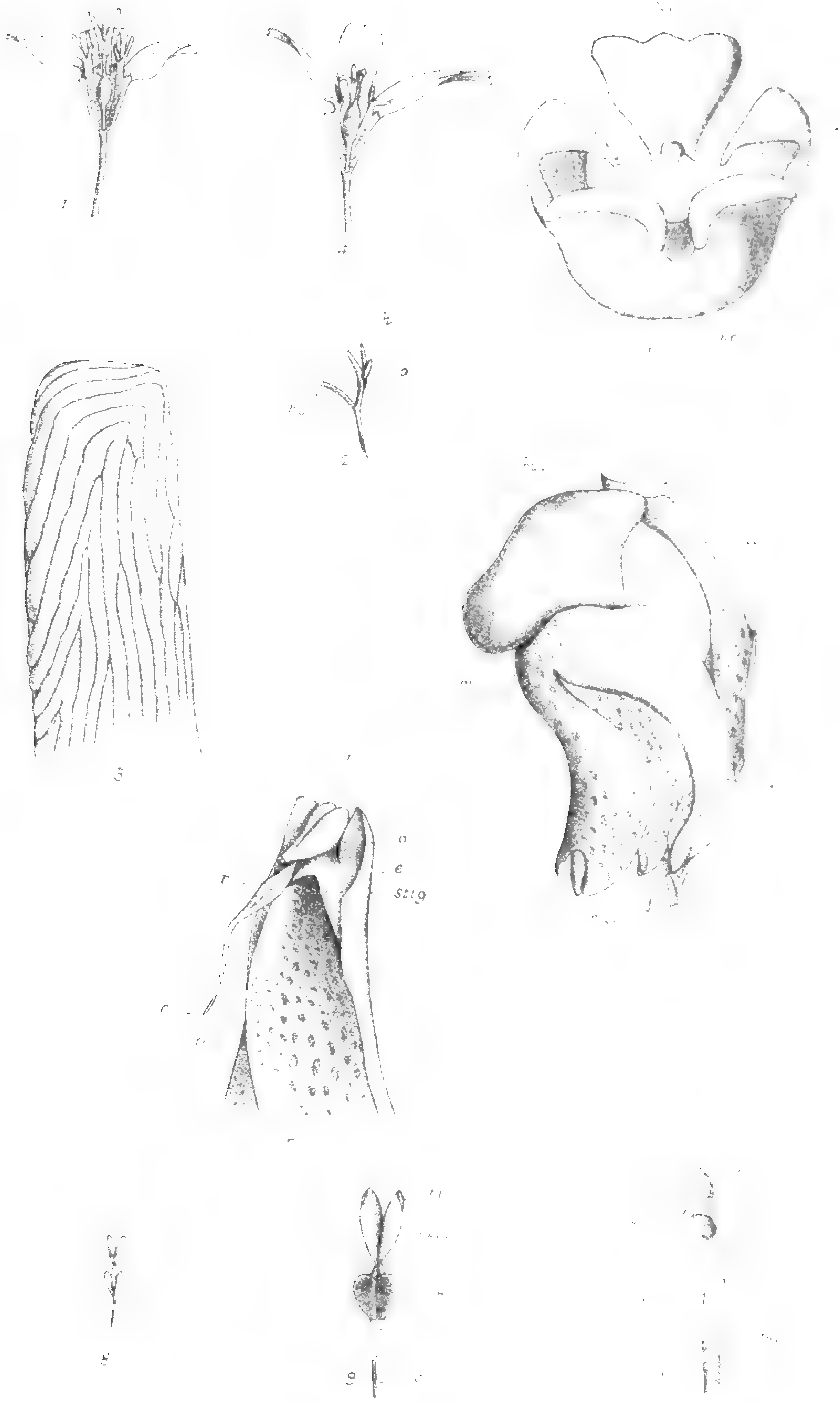
PLATE XVIII.

Fig. 1. *Brodiæa ixioides.* Flower, with half of perianth removed, in early stage; from a photograph. Nat. size.
2. Do. Stamen with section of perianth. Nat. size.
3. Do. Tip of horn of stamen. ×50.
4. Do. Flower in late stage; from a photograph. Nat. size.
5. *Stanhopea tigrina.* Labellum and column in natural pendent position; the rest of the perianth removed; from a photograph. ×$\frac{3}{5}$.
6. Do. The same organs viewed from below, showing the form of the mouth of the cage; from a photograph. ×$\frac{5}{7}$.
7. Do. The apex of the column with the anther, &c.; from a photograph. ×$2\frac{1}{2}$.
8. Do. Pollinia, rostellum, &c. from above. Nat. size.
9. Do. The same from below. ×2.
10. Do. Long. sect. apex of column, with pollinia and anther removed. Nat. size.

PLATE XIX.

Fig. 11. *Pimelea decussata.* Top of flower in early stage. Nat. size.
12. Do. The same, in intermediate stage. Nat. size.
13. Do. Final stage. Nat. size.
14. *Cotyledon Umbilicus.* Flower. Nat. size.
15. Do. Young flower seen from the mouth. ×8.
16. Do. Stigma of young flower, from side. ×6.
17. Do. Stigma of old flower, from side. ×6.
18. *Hydrolea spinosa.* Ovary and styles. ×2.
19. Do. Part of corolla, with stamens attached, to show the processes; it has been flattened out somewhat in order to separate these. ×$1\frac{1}{2}$.
20. Do. Cross section of flower, just above the ovary. ×4.
21. *Salvia Verbenaca.* Cleistogamous flower of the smallest size, after fertilization. The corolla has become detached and moved forwards, so as to be visible beyond the calyx, which was not the case before fertilization. ×$\frac{4}{3}$.
22. Do. Corolla of same flower. ×6.
23. Do. Corolla with upper lip removed, showing the stamens and style. The dotted lines show their position in the lower lip. ×6.
24. Do. Larger flower, open at mouth. ×3.
25. Do. Largest flower. ×$1\frac{3}{4}$.
26. *Viola tricolor.* Flower with corolla reduced, especially the upper lip.

a=anther; *b*=projecting end of column; *c*=tip of rostellum; *cp*=carpel; *c.par*=conducting parenchyma; *col*=column; *d*=central ridge of column; *e*=ridge, bearing anther; *epi*=epichil; *f*=lateral bar of cage; *h*=horn of stamen; *hyp*=hypochil (bucket); *k*=tip of ridge after removal of anther; *m*=cavity in pollinium; *mes*=mesochil; *n*=nectary visible through corolla; *pet*=petal; *p.s*=perianth lobe; *pol*=pollinium; *r*=rostellum; *st*=stamen; *stig*=stigma; *sty*=style; *v.b*=vascular bundles.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J.C.W. del.
J.N. Fitch lith.

11-13, PIMELEA 14-17, COTYLEDON 18-20, HYDROLEA
21-25 SALVIA 26, VIOLA

On certain Authentic *Cyperaceæ* of Linnæus.

By C. B. Clarke, M.A., F.L.S.

[Read 15th March, 1894.]

I have, many times, worked through the Cyperaceæ (other than *Carex*) in the herbarium of Linnæus preserved in this room, and have compared them with the volumes of the two editions of the 'Species Plantarum' annotated in Linnæus's handwriting. The herbarium of Linnæus appears to have originally contained a perfect, or very nearly perfect, set of examples (one, two, or rarely more, sheets of each species) representing the Sp. Pl. ed. i. Each sheet of this set was numbered and named in the hand of Linnæus, in ink, on the paper itself, the numbers corresponding always to the species-numbers in the *first* edition of the Sp. Pl.

The herbarium of Linnæus has been, as is well known, disarranged: a quantity of additional material has been mixed into it; some of the original names have been crossed out; some of the original sheets have been moved, and many have disappeared altogether. There still remain, however, in the Cyperaceæ enough of these authentically named sheets to verify more than half the species described by Linnæus in his Sp. Pl. From comparing these so many times, I have come to the conclusion that we possess, in them, in every case, a specimen plant that Linnæus himself referred to the name he wrote on them. Besides these (usually numbered) specimens there are a good many other sheets named in Linnæus's hand (but without numbers) which refer to species subsequently published under Linnæus's names in the Sp. Pl. ed. ii., in the Mantissa, and in Linn. f. Suppl.

These authentic examples are not, however, the "types" of Linnæus's species in the sense understood by many modern botanists. Linnæus conceived a species as an entity and did not suppose that it could be restricted to one "type." A "species," in his Sp. Pl., is made up of 4 (or fewer) parts, viz. (*a*) the citations of predecessors; (*b*) the citations of pictures; (*c*) the diagnosis of Linnæus himself; (*d*) the authentic examples in Linnæus's herbarium. Perhaps the most important of these four is the first: Linnæus meant invariably that his species should be the sp. auct. of his day; Linnæus generally draws his diagnosis by directly copying from his predecessors, only altering it so far as to make it include his authentic specimens. Where, as is frequently the case, his authentic specimens were wrong, these alterations of his predecessors' diagnoses introduce difficulties that can only be dealt with, as best they may, for each individual case. The pictures cited by Linnæus I find of small value, at least in the Cyperaceæ (and a few other cases where I have tested them). In the first place, the pictures of Linnæus's day were poor, and it is often difficult to feel any confidence as to what species they belonged to. They often give no detail, but so very general a view of the plant that it is impossible to be certain to which species, among half a dozen as species are now recognized, the figure exactly belongs. In very many cases, all I can say is that the figure may do for the plant we call it. Secondly, even when the figures were good, Linnæus seems to have allowed for a good deal of variability in the plant and imagination in the artist. It is, in a word, my opinion that a large percentage of the figures cited by Linnæus are wrong, or very doubtful. From the foregoing data we have to decide in each case to what plant we will apply each Linnæan specific name. I have formerly, as in Journ. Linn. Soc. vol. xxi. [1884] pp. 34–202, retained I believe every Linnæan name for the name of some species (now known more or less generally by such name) by the resource of citing Linn. *partim*; as "*Cyperus Haspan*, Linn. *partim*": in this case Linnæus meant by *Cyperus Haspan* the plant that we do, including several which we specifically separate, but Linnæus's authentically-named *Cyperus Haspan* is a totally different plant, and his diagnosis is therefore unsatisfactory. I can hardly expect systematists to be of one mind how far we ought to strain facts in order to avoid wholesale alteration of present names—the "nomina auctorum." Thus "*Scirpus supinus*, Linn.," is a widespread and universal species, of which the name has never been doubted; but the authentically-named plant is "*Alisma ranunculoides*, Linn." I think even here from the citations of his predecessors and the groundwork of his diagnosis that Linnæus really meant our *Scirpus supinus*, and I retain the name accordingly.

The case is different where the diagnosis of Linnæus (or any other author) is fundamentally wrong, *i. e.* states as a character of the species an essential point that is *never* to be found in the species now so named. In this case also it is usual to cite "Linnæus partim" or "Linnæus emend."; but such a citation is only complimentary or traditional and often very misleading.

We have to look down into the synonymy and see what species of Kunth or DC. is really meant: it is therefore, I believe, better to cite the species in chief as of Kunth or DC. and to place the "Linn. emend." among the synonymy.

In the reduction of Linnæus Sp. Pl., so far as they are represented by authenticated specimens, which reductions form the substance of the present paper, I have been able to retain all the specific names, nearly in their commonly received sense, except two, viz.:—(1) *Cyperus elegans*, Linn., is *altogether* (*i.e.* diagnosis, picture cited, and specimens) the plant which Rottboell calls *elegans*, and moderns call *C. viscosus*, Aiton. The plant called *Cyperus elegans* by Swartz and Kunth is a totally different species, viz. what we call *C. diffusus*, Vahl. (2) The name *Cyperus odoratus*, Linn., has been largely employed by botanists: all that can be gathered from the diagnosis is that it was a large species; from the figures of Sloane cited, some botanists have imagined it to be a species of "*Diclidium*" closely allied to *Mariscus ferax* (*Cyperus ferax*, L. C. Rich.); others have supposed it equal to *Cyperus strigosus*, Linn., or one of the species closely allied thereto. Linnæus has, however, two good specimens on his authentically named sheet: one is *Pycreus polystachyus*, Beauv., the other is *Cyperus malaccensis*, Lam. Upon these data, I call *Cyperus odoratus*, Linn., *nomen delendum.*

There has been much dispute of late regarding the citation and treatment of the Linnæan genera. The first genus of Linnæus's Cyperaceæ is *Schœnus*, which in the 1st edition of the Sp. Pl. contains 9 species. These are referred now as follows:—2 to *Schœnus*, 1 to *Cladium*, 1 to *Cyperus*, 1 to *Kyllinga*, 1 to *Scirpus*, 2 to *Rynchospora*, 1 to *Crypsis* (a Grass).

[In the 2nd edition of the Sp. Pl. three new Schœni sp. are added; of these 1 is *Dulichium*, 1 is *Tetraria*, 1 is *Scleria.*]

The modern genus *Schœnus* contains 60 species, mostly Australian, and in Benth. et Hook. f. Gen. Pl. vol. iii. p. 1062, Bentham cites it as "*Schœnus*, Linn., *pro parte.*" Bentham cites it from the 5th edition of the Genera [1767], whereas some say he ought to have cited it from the 2nd edition [1742]; that makes no difference whatever. The character of the genus, given by Linnæus, opens with "petals 6," which character cannot, in Linnæus's idea of petals, be forced to be true either of any one of Linnæus's 12 species, or any one of the 60 species now in *Schœnus*.

It is frequently said that Linnæus's genera are our Suborders or Tribes, and that when we make a Tribe of 6 or 8 genera out of one of Linnæus's genera it is well to apply the Linnæan name to the largest or most characteristic genus, *pro parte*. But nothing of the kind can be said here; Linnæus's eleven *Schœni* sp. are taken at haphazard throughout the Order (the grass being thrown in) from the most remote and unlike genera. To call the present genus "*Schœnus*, Linn.," in any sense, or even "pro parvâ parte," is wholly complimentary.

When I have brought these things to the notice of some experienced botanists, they have attempted to evade any general conclusions thence as to how the genera and species of Linnæus are to be treated by observing that the Cyperaceæ are unlike other orders, and that Linnæus's treatment of other orders will be found different. I have tried several other orders, and it appears to me that Linnæus worked in just the same way throughout: he took the diagnoses of his predecessors, he identified the pictures very boldly, he made his diagnosis include somehow his type specimens.

Here follows a reduction of all the Cyperaceæ (except *Carex*) now in the Linnæan Herbarium, which have their names written on the sheets in the hand of Linnæus.

Where we still keep the species (whole or part) in the same genus in which Linnæus placed it, I have further considered in what form the citation of it should be made. Where the species is now to be placed under some genus later than Linnæus, it is not requisite to expend thought or time on the citation of Linnæus under the synonymy.

SCHŒNUS MARISCUS, *Sp. Pl.* ed. 1, p. 42, n. 1.

There are two sheets marked, the first "Mariscus 1" in Linnæus's hand, the second "Schœnus Mariscus" in Linnæus's hand; they are both

=CLADIUM JAMAICENSE, *Crantz*.

The diagnosis and citations of Linnæus agree.

SCHŒNUS ACULEATUS, *Sp. Pl.* ed. 1, p. 42, n. 2.

The plant marked in Linnæus's hand *Schœnus Mariscus* has been ticketed as subsequently *Sch. aculeatus* of the Sp. Pl.—quite wrongly. The description, the figure of Morison cited by Linnæus, and his other references show that *Sch. aculeatus*, Linn., was altogether

CRYPSIS ACULEATA, *Aiton.*

SCHŒNUS MUCRONATUS, *Sp. Pl.* ed. 1, p. 42, n. 3.

One sheet marked "*Schœnus mucronatus*" in Linnæus's hand.

Schœnus mucronatus, Linn., as to the diagnosis, citations, and plant named, is altogether

CYPERUS CAPITATUS, *Vandelli.*

SCHŒNUS NIGRICANS, *Sp. Pl.* ed. 1, p. 43, n. 4.

There are two sheets marked, the first "4. nigricans" in Linnæus's hand, the second "4" in Linnæus's hand.

Schœnus nigricans, Linn., as to the diagnosis, citations, and examples, is GOOD.

SCHŒNUS FERRUGINEUS, *Sp. Pl.* ed. 1, p. 43, n. 5.

One sheet, marked "5. ferrugineus" in the hand of Linnæus.

Schœnus ferrugineus, Linn., as to diagnosis, citations, and examples, is GOOD.

SCHŒNUS COLORATUS, *Sp. Pl.* ed. 1, p. 43, n. 6.

Two sheets: the first, marked "Schœnus coloratus" in Linnæus's hand, is *Kyllinga brevifolia*, Rottb.; the second, marked "coloratus" in Linnæus's hand, is *Mariscus coloratus*, Nees.

The second sheet (i. e. *Mariscus coloratus*) is supposed to belong to Var. β in ed. 2, p. 64; *i. e.* it is *Scirpus glomeratus*, Linn. Sp. Pl. ed. 1, p. 52.

A third sheet, marked "glomeratus" in Linnæus's hand, is *Kyllinga monocephala*, Rottb.

The picture cited by Linnæus, viz. "Sloane Jamaica, t. 78. fig. 1," is *Dichromena*.

SCHŒNUS GLOMERATUS, *Sp. Pl.* ed. 1, p. 44, n. 8.

One sheet, marked "8. glomeratus" in Linnæus's hand, is *Rynchospora glomerata*, Vahl.

Schœnus glomeratus, Linn., is, as to diagnosis, citation, and example,

RYNCHOSPORA GLOMERATA, *Vahl.*

SCHŒNUS ALBUS, *Sp. Pl.* ed. 1, p. 44, n. 9.

One sheet, marked "9. albus" in Linnæus's hand, is *Rynchospora alba*, Vahl, *a*.

[A second sheet, marked "albus," perhaps not in Linnæus's hand, is also *R. alba*, Vahl, *a*.]

Schœnus albus, Linn., as to diagnosis, citation, and example, is
RYNCHOSPORA ALBA, *Vahl, a.*

SCHŒNUS CAPENSIS, *Sp. Pl.* ed. 2, p. 64, n. 7.

One sheet, named in Linnæus's hand "Capensis." The word "Capensis" has been struck out and "thermalis" substituted by another hand. The plant is *Tetraria thermalis*: it does not suit Linnæus's description at all.

Schœnus capensis, Linn., as to descr. is referred by Kunth to *Thamnochortus dichotomus*, R. Br.; but Dr. Masters does not accept this determination.

The plant marked by Linnæus as "Capensis" is according to Richter the foundation for *Schœnus thermalis*, Linn., Mant. p. 179.

A sheet, now in the *Schœnus* bundle, and marked in Linnæus's hand "fuscus," is
RYNCHOSPORA FUSCA, *Link.*

CYPERUS ARTICULATUS, *Sp. Pl.* ed. 1, p. 44, n. 1.

One sheet, marked "1. articulatus" in Linnæus's hand, is *C. articulatus.*

Cyperus articulatus, Linn., as to diagnosis, citations, and example, is GOOD.

CYPERUS TENELLUS, *Linn. f. Suppl.* p. 103.

One sheet, marked "tenellus" in Linnæus's hand, is CYPERUS TENELLUS.

CYPERUS MONOSTACHYOS, *Linn. Mant.* p. 180.

One sheet, marked "Cyperus monostachyos" in Linnæus's hand, is FIMBRISTYLIS MONOSTACHYA, *Hassk.*

CYPERUS LÆVIGATUS, *Linn. Mant.* p. 179.

One sheet, marked "Cyperus lævigatus" in Linnæus's hand, is JUNCELLUS LÆVIGATUS, *C. B. Clarke.*

CYPERUS HASPAN, *Sp. Pl.* ed. 1. p. 45, n. 4.

One sheet, marked "4. haspan" in Linnæus's hand, is *Cyperus Iria*, Linn.

The diagnosis and the figure of Plukenet cited are *Cyp. Haspan*; and the species must stand:—

CYPERUS HASPAN, *Linn. Sp. Pl.* ed. 1, p. 45 et ed. 2,
p. 66, neque herb. propr.

CYPERUS LONGUS, *Sp. Pl.* ed. 1, p. 45, n. 5.

One sheet, two examples, marked "5. longus" in Linnæus's hand, are both *Juncellus serotinus* (Rottb. sub *Cypero*).

The figure of Morison, Hist. sect. 8, t. 11. fig. 13, is, I think, *C. esculentus.* (Certainly not *C. longus*, of which species an important character is that the stem is not erect at base.)

Rather than change the name of *C. longus*, Linn., I propose that our English plant shall be called

CYPERUS LONGUS, *Linn. Sp. Pl.* ed. 1, p. 45 partim
(tab. citat. et exemplo in hb. propr. excl.).

CYPERUS ROTUNDUS, *Sp. Pl.* ed. 1, p. 45, n. 6.

Two sheets, one marked "rotundus 6" in Linnæus's hand, is *Mariscus*, perhaps *Mariscus tabularis* (*C. tabularis*, Schrad.). The example is young, but remote from *C. rotundus.*

The other sheet, marked "rotundus" in Linnæus's hand, is *Cyperus esculentus.*

This species must stand:—

CYPERUS ROTUNDUS, *Linn. Sp. Pl.* ed. 1, p. 45,
neque herb. propr.

CYPERUS SQUARROSUS, *Sp. Pl.* ed. 2, p. 66, n. 3.

One sheet, marked in Linnæus's hand "pumilus," but this name struck out and "squarrosus" substituted, all in Linnæus's hand, contains two things: one is a tuft of many complete plants of *Cyperus aristatus*, Roxb.; the other is a single head of *Mariscus squarrosus.*

The plate of Plukenet cited by Linnæus is probably neither of these.

All that can be done with Linnæus's name is to reduce it:—

{ partim = *Cyperus aristatus*, Rottb.
{ partim = *Mariscus squarrosus* (Linn. sub *Cypero*).

CYPERUS DIFFORMIS, *Sp. Pl.* ed. 2, p. 67, n. 8.

Three sheets, one marked "Cyperus difformis," the second "C. diformis," the third "Scirp. deformis," all in Linnæus's hand all are *Cyperus difformis.*

The reference to Plukenet, t. 317. fig. 5, is a misprint for t. 417. fig. 5, which is *C. difformis.*

Cyperus difformis, Linn., is, as to diagnosis, citation, and examples, GOOD.

CYPERUS IRIA, *Sp. Pl.* ed. 1, p. 45, n. 8.

One sheet, originally marked "8. Iria" in Linnæus's hand, but "Iria" struck out and "haspan" substituted, also by Linnæus's hand, contains two good specimens, whereof one is *C. Iria*, Linn., the other *C. diffusus*, Vahl.

The figure cited of Plukenet (Alm. t. 191. fig. 7) is *C. Iria*; that cited of Rheede (Hort. Malab. vol. xii. t. 56) is *Juncellus inundatus*, Roxb. (sub *Cypero*).

This species may be cited:—

CYPERUS IRIA, *Linn. Sp. Pl.* ed. 1, p. 45 (tab. Rheedei
citat. excl.), et herb. propr. partim.

CYPERUS ELATUS, *Sp. Pl.* ed. 2, p. 67, n. 10.

One sheet, marked "Cyp. elatus" in Linnæus's hand, is the species I have so called in Journ. Linn. Soc. vol. xxi. [1884], p. 189, and is called *C. racemosus* by Steudel and Boeck.; but I regard it as very doubtful what *C. racemosus*, Retz., really was (Arnott considered it to have been *C. digitatus*, Roxb.). At all events, the description of Linnæus in the Amœn. Acad. vol. iv. p. 301, altogether agrees with his authentic specimen; and I apply to the plants Wallich 3341 A, Zollinger 350, the name

CYPERUS ELATUS, *Linn.*

CYPERUS GLOMERATUS, *Sp. Pl.* ed. 2, p. 68, n. 12.

Two sheets, each marked "glomeratus" in Linnæus's hand.

Cyperus glomeratus, Linn., is altogether (*i. e.* diagnosis, figures cited, and authentic specimens) GOOD.

CYPERUS ELEGANS, *Sp. Pl.* ed. 1, p. 45, n. 9.

One sheet, marked "9. Cyp. elegans" in the hand of Linnæus, is *Cyperus elegans*, Linn., *i.e. C. viscosus*, Aiton, and NOT *C. elegans* of Swartz and Kunth.

The description of Linnæus fits *C. viscosus*, Aiton, exactly, and will not fit *C. elegans*, Kunth. The figure of Sloane cited [t. 75. fig. 1] is also *C. elegans*, Linn.

We have CYPERUS ELEGANS, *Linn.* (and Rottb.), GOOD.

The *Cyperus elegans* of Swartz and Kunth will be *C. diffusus*, Vahl.

CYPERUS ODORATUS, *Sp. Pl.* ed. 1, p. 46, n. 10.

There is one sheet, marked "10. odoratus" in Linnæus's hand,

and containing two good complete specimens; one is *Pycreus polystachyus*, Beauv., the other is *Cyperus malaccensis*, Lam.

Linnæus cites two plates for his *C. odoratus*, viz. Sloane, t. 74. fig. 1, and t. 8. fig. 1. As regards the first of these plates, cyperologists are not agreed to what section it refers: some suppose it to represent a *Mariscus* near *M. strigosus*; others suppose it to represent a *Diclidium* and to be equal to or near *Cyperus ferax*, L. C. Rich. As regards Sloane's other plate, t. 8. fig. 1, it doubtless represents one of the Papyri near *C. giganteus*, Vahl.

As to Sloane, t. 74. fig. 1, the spikelets appear to me much too broad for any *Diclidium*. It is true that, in the older stages of *Diclidium*, the glumes stand out very stiffly and the spikelets are then in outline broad, though the outline is very broken; but Sloane's plate represents the glumes very closely imbricated; in the young state of *Diclidium* (*Cyperus ferax*, L. C. Rich.), before the glumes spread, the spikelets are linear.

Cyperus odoratus, Linn., is (mihi) *nomen omnino delendum.*

CYPERUS COMPRESSUS, *Sp. Pl.* ed. 1, p. 46, n. 11.

One sheet, marked "Cyperus compressus" in Linnæus's hand, is *C. compressus.*

Cyperus compressus, Linn., is altogether (as to diagnosis, picture cited, authentic example) GOOD.

CYPERUS FLAVESCENS, *Sp. Pl.* ed. 1, p. 46, n. 12.

One sheet, marked "12. flavescens" in Linnæus's hand, is *Pycreus rivularis*, a North-American sp. nearly allied to the European *Pycreus flavescens*, Nees. Boott has consequently in MS. in the Mus. Brit. named some of the American plant *Cyperus flavescens*, Linn.

From the citations it is clear that Linnæus meant the European *Pycreus flavescens*, Nees, for his species. Under PYCREUS FLAVESCENS, *Nees*, I cite accordingly *Cyperus flavescens*, Linn. Sp. Pl. ed. 1, p. 46, neque herb. propr.

CYPERUS PUMILUS, *Sp. Pl.* ed. 2, p. 69, n. 17.

One sheet, named "Cyperus humilis" in Linnæus's hand, but the word "humilis" struck out and "pumilus" substituted, also by Linnæus's hand, contains two specimens. One of these I take to be original and is *Pycreus nitens*, Nees (= *C. pumilus*, Linn.). The other specimen is marked "Hort. Fothergill, 1778.

Fairbairn. J. E. S.;" and I suppose to have been added by Sir J. E. Smith; it is *Pycreus flavescens*, Nees.

Under PYCREUS NITENS, *Nees*, I cite *Cyperus pumilus*, Linn., Sp. Pl. ed. 2, p. 69.

CYPERUS TRIFLORUS, *Linn. Mant.* p. 180.

One sheet, marked "Cyperus triflorus" in Linnæus's hand, is *Fimbristylis tristachya*, Thw.

CYPERUS STRIGOSUS, *Sp. Pl.* ed. 1, p. 14, p. 47.

One sheet, marked "14. strigosus" in Linnæus's hand, is *Mariscus strigosus*. The figure cited, viz. Sloane, Jamaica, t. 74. figg. 2, 3, cannot (in my judgment) have been drawn from *M. strigosus* [I think t. 74. fig. 1 perhaps was]. Under MARISCUS STRIGOSUS I cite *C. strigosus*, Linn. Sp. Pl. ed. 1, p. 14, n. 47 (tab. Sloane excl.), et herb. propr.

CYPERUS LIGULARIS, *Sp. Pl.* ed. 2, p. 70, n. 19.

One sheet, marked "Cyp. ligularis" in Linnæus's hand, is *Mariscus rufus*, H. B. K.—*Cyperus ligularis*, Linn., is (as to diagnosis, picture cited, and authentic example) *Mariscus rufus*, H. B. K.

CYPERUS PAPYRUS, *Sp. Pl.* ed. 1, p. 47, n. 15.

One sheet, marked "Papyrus" in Linnæus's hand, is *Cyperus Papyrus*, Linn.

Linnæus's diagnosis of this species is remarkable—"umbellâ simplici, pedunculis simplicissimis distiche spicatis." But I think there is no doubt that Linnæus had the right plant; and I make CYPERUS PAPYRUS, *Linn.*, to be GOOD.

CYPERUS ARUNDINACEUS, *Sp. Pl.* ed. 1, p. 44, n. 3.

C. ferrugineus, *Sp. Pl.* ed. 2, p. 63 in citat.

Schœnus spathaceus, *Sp. Pl.* ed. 2, p. 63, n. 4.

One sheet, marked originally "3. arundinaceus" in Linnæus's hand. He then struck out "arundinaceus" and substituted "alternifolius;" he then struck out "alternifolius" and substituted "vaginatus," which now stands on the sheet. The plant is *Dulichium spathaceum*, L. C. Rich.

The diagnoses and citations of Linnæus agree; and his three names above are all reduced under DULICHIUM SPATHACEUM, L. C. Rich.

CYPERUS ALTERNIFOLIUS, *Linn. Mant.* p. 28.

One sheet, marked by Linnæus "Cyperus alternifolius," is our commonly cultivated species so named.

CYPERUS DISTANS, *Linn. f. Suppl.* p. 103.

One sheet, marked "distans" in Linnæus's hand, is *C. distans*, "auct." (i. e. *C. elatus*, Presl, in Oken, Isis, vol. xxi. [1828] p. 271, non Linn.).

In the *Cyperus* bundle is one sheet marked *Cyperus pannonicus*; on this Linnæus wrote "Scirpus Michelianus?" The plant is really *Cyperus fuscus*, Linn.

In the *Cyperus* bundle are two sheets, named in Linnæus's hand "annuus." They are *Cyperus fuscus*, Linn.

SCIRPUS TRIGYNUS, *Linn. Mant.* p. 180.

One sheet, marked "Scirpus trigynus" in Linnæus's hand, is FICINIA SCARIOSA, *Nees*.

SCIRPUS MUTATUS, *Sp. Pl.* ed. 2, p. 71, n. 4.

One sheet, marked "Scirpus mutatus" in Linnæus's hand, is *Eleocharis mutata*.

The description, citation, and plant of *Scirpus mutatus*, Linn., are ELEOCHARIS MUTATA, *R. Br.*

SCIRPUS ARTICULATUS, *Sp. Pl.* ed. 1, p. 47, n. 1.

One sheet, marked "articulatus" in Linnæus's hand, is *Scirpus articulatus*, Linn.

The diagnosis, the picture cited, and the authentic example are all SCIRPUS ARTICULATUS, *Linn.*

SCIRPUS PALUSTRIS, *Sp. Pl.* ed. 1, p. 47, n. 2.

Two sheets, viz.:—

A, marked by Linnæus "palustris 2," is *Eleocharis palustris*, R. Br.

B, marked by Linnæus "palustris," is *Eleocharis multicaulis*, Smith.

The description of Linnæus includes both plants.

Scirpus palustris, Linn., therefore, is—
partim =*Eleocharis palustris*, R. Br.
partim =*E. multicaulis*, Smith.

SCIRPUS GENICULATUS, *Sp. Pl.* ed. 1, p. 48, n. 3.

One sheet, marked "Scirpus geniculatus 3" in Linnæus's hand, is *Eleocharis interstincta*, R. Br.

Of the two figures of Sloane cited by Linnæus, t. 81. fig. 3 is *Eleocharis geniculata*, R. Br.; t. 75. fig. 2 is not.

Under ELEOCHARIS GENICULATA, *R. Br.*, therefore, I cite *Scirpus geniculatus*, Linn. Sp. Pl. ed. 1, p. 48, partim.

SCIRPUS CÆSPITOSUS, *Sp. Pl.* ed. 1, p. 48, n. 4.

One sheet, marked " cæspitosus " in Linnæus's hand, is *Scirpus cæspitosus*, Linn.

[An added sheet marked " 4," perhaps by Linnæus's hand, is *Scirpus pauciflorus*, Lightf.

The figure cited, Scheuchz. Gram. t. 7. fig. 18, is *S. cæspitosus*.]

I make *Scirpus cæspitosus*, Linn., therefore GOOD.

SCIRPUS CAPITATUS, *Sp. Pl.* ed. 1, p. 48, n. 5.

Two sheets, viz.:—

A, marked " Scirpus capitatus 5 " in Linnæus's hand, is *Eleocharis capitata*, R. Br.

B, marked "capitatus" in Linnæus's hand, is *Eleocharis ovata*, R. Br.

Under ELEOCHARIS CAPITATA, *R. Br.*, I cite *Scirpus capitatus*, Linn.

SCIRPUS ACICULARIS, *Sp. Pl.* ed. 1, p. 48, n. 6.

The plant is too young for me to determine; but may be *Eleocharis acicularis*, R. Br.

SCIRPUS LACUSTRIS, *Sp. Pl.* ed. 1, p. 48, n. 8.

Two sheets, viz.:—

A, marked " 8. lacustris " in Linnæus's hand, is *Scirpus lacustris*, Linn.

B, marked " lacustris " in Linnæus's hand, is *Scirpus pungens*, Vahl.

SCIRPUS HOLOSCHŒNUS, *Sp. Pl.* ed. 1, p. 49, n. 9.

One sheet, marked by Linnæus's hand " 9. Holoschœnus," is *Scirpus Holoschœnus*, Linn.

SCIRPUS ROMANUS, *Sp. Pl.* ed. 1, p. 49, n. 10.

One sheet, marked by Linnæus's hand " 10. Romanus," is *Scirpus Holoschœnus*, Linn.

SCIRPUS SETACEUS, *Sp. Pl.* ed. 1, p. 49, n. 11.

Two sheets, viz.:—

A, marked " 11. setaceus " in Linnæus's hand, is *Scirpus cernuus*, Vahl.

B, marked "Scirpus setaceus" in Linnæus's hand, is too young for certain determination, but appears to me to be also *Scirpus cernuus*, Vahl.

The figure cited, Morison, sect. 8, t. 10. fig. 23, will do equally well for *S. setaceus* or *S. cernuus*.

I think it is certain that Linnæus would reckon *S. setaceus* and *S. cernuus* one species. Now that these are separated, I keep the name *Sc. setaceus*, Linn., for the plant. auctorum [*cf.* Benth. Fl. Austral. vii. p. 327].

SCIRPUS SUPINUS, *Sp. Pl.* ed. 1, p. 49, n. 12.

One sheet, marked in Linnæus's hand "12. supinus," is *Alisma ranunculoides*, Linn.

The description of Linnæus will not apply at all to this *Alisma*. The species will therefore stand

SCIRPUS SUPINUS, *Linn. Sp. Pl.* p. 49, ed. 2, p. 73,
neque herb. propr.

SCIRPUS AUTUMNALIS, *Linn. Mant.* p. 180.

One sheet, marked "Scirpus autumnalis" in Linnæus's hand, is FIMBRISTYLIS AUTUMNALIS, *Roem. et Sch.*, var. β. geminata (sp.), *Kunth.*

SCIRPUS CAPILLARIS, *Sp. Pl.* ed. 1, p. 49, n. 13.

One sheet, marked "13. capillaris" in Linnæus's hand, is *Bulbostylis capillaris*, Kunth.

Of the two pictures cited by Linnæus, Burm. Zeyl. t. 47. fig. 2, is probably *Bulbostylis capillaris*; Pluk. Alm. t. 300. fig. 5, certainly not.

Under BULBOSTYLIS CAPILLARIS, *Kunth*, I cite *Scirpus capillaris*, Linn. Sp. Pl. ed. 1, p. 49 (tab. Pluk. citat. excl.).

SCIRPUS TRISTACHYOS, *Linn. f. Suppl.* p. 103.

Two sheets, marked "tristachyos" in Linnæus's hand, are FICINIA TRISTACHYA, *Nees* (vix Kunth, who excludes Linn., but admits Rottb.).

[Added is one sheet marked, not by Linnæus, *Scirpus trispicatus*, Linn. f. Suppl.; this is *Ficinia sylvatica*, Kunth.]

SCIRPUS MUCRONATUS, *Sp. Pl.* ed. 1, p. 50, n. 14.

One sheet, marked "14. mucronatus" in Linnæus's hand, is *Scirpus mucronatus*, Linn.

Of the figures cited by Linnæus, Pluk. Alm. t. 40. figg. 1, 3, is right; Morison, Hist. sect. 8, t. 10. fig. 20, is wrong.

I cite the species as *Scirpus mucronatus*, Linn. Sp. Pl. & ed. 1, p. 50 (tab. Morison citat. excl.).

SCIRPUS GROSSUS, *Linn. f. Suppl.* p. 104.

Two sheets, marked "grossus" in Linnæus's hand, are

SCIRPUS GROSSUS, *Linn. f.*

SCIRPUS ECHINATUS, *Sp. Pl.* ed. 1, p. 50, n. 16.

One sheet, marked "16. echinatus" in Linnæus's hand, is

MARISCUS OVULARIS, *Vahl.*

Linnæus has united under the above name two plants: one, from Virginia, is *Mariscus ovularis*, Vahl; the other, from Ceylon, is *Mariscus paniceus*, Vahl.

SCIRPUS RETROFRACTUS, *Sp. Pl.* ed. 1, p. 50, n. 17.

One sheet, marked "17. retrofractus" in Linnæus's hand, is

MARISCUS RETROFRACTUS, *Vahl.*

The figure cited by Linnæus (Pluk. Amalth. t. 415. fig. 4) is right; though Plukenet says the plant came from Malabar, whereas *Mariscus retrofractus* is wholly North-American.

SCIRPUS FERRUGINEUS, *Sp. Pl.* ed. 1, p. 50, n. 18.

One sheet, marked "Scirpus ferrugineus" in Linnæus's hand, contains two plants, viz.:—

1. *Fimbristylis ferruginea*, Vahl.
2. *Fimbristylis diphylla*, Vahl.

The figure cited, Sloane, t. 77. fig. 2, is right. I add *Scirpus ferrugineus*, Linn., as a synonym to *Fimbristylis ferruginea*, Vahl.

SCIRPUS SPADICEUS, *Sp. Pl.* ed. 1, p. 51, n. 19.

One sheet, marked "19. spadiceus" in Linnæus's hand, is

FIMBRISTYLIS SPADICEA, *Vahl.*

The figure cited by Linnæus, Sloane, t. 76. fig. 2, is right.

I make *Scirpus spadiceus*, Linn., a synonym of *Fimbristylis spadicea*, Vahl.

SCIRPUS MILIACEUS, *Sp. Pl.* ed. 2, p. 75, n. 22.

One sheet, marked "miliaceus" in the hand of Linnæus, is

FIMBRISTYLIS QUINQUANGULARIS, *Kunth.*

Linnæus would surely have esteemed *Fimbristylis miliacea*, Vahl, and *F. quinquangularis*, Kunth, one species. I doubt the advisability of keeping them distinct. I cite *Scirpus miliaceus*, Linn., as a synonym under *Fimbristylis miliacea*, Vahl.

SCIRPUS CYPEROIDES, *Linn. Mant.* p. 181.

One sheet, marked "Scirpus cyperoides" in Linnæus's hand, is
MARISCUS SIEBERIANUS, *Nees*.

SCIRPUS MARITIMUS, *Sp. Pl.* ed. 1, p. 51, n. 20.

Two sheets, viz.:—

A, marked "20. maritimus" in Linnæus's hand, is
SCIRPUS MARITIMUS, *Linn.*

B, marked "maritimus singularis" in Linnæus's hand, and noted in the interleaf of his second edition, is *S. maritimus*, Linn., forma spicis elongatis.

Scirpus maritimus, Linn., is (altogether) GOOD.

SCIRPUS LUZULÆ, *Sp. Pl.* ed. 2, p. 75, n. 23.

One sheet, marked "Sc. Luzulæ" in Linnæus's hand, is
CYPERUS LUZULÆ, *Retz.*

Linnæus gives the habitat "India," by which we must understand the West Indies. I cite *Scirpus Luzulæ*, Linn., as a synonym under CYPERUS LUZULÆ, *Retz.*

SCIRPUS SYLVATICUS, *Sp. Pl.* ed. 1, p. 51, n. 22.

One sheet, marked "22. sylvaticus" in Linnæus's hand, is
SCIRPUS SYLVATICUS, *Linn.*

The figure cited by Linnæus, Loesel Pruss. t. 33, is right.

Scirpus sylvaticus, Linn., is (altogether) GOOD.

SCIRPUS CORYMBOSUS, *Linn. Amœn. Acad.* vol. iv. p. 303, et *Sp. Pl.* ed. 2, p. 76, n. 25.

One sheet, marked "S. corymbosus" in Linnæus's hand, is *Rynchospora aurea*, Vahl.

The description agrees, and *S. corymbosus*, Linn., has been reduced by all modern authors to RYNCHOSPORA AUREA, *Vahl.*

SCIRPUS SQUARROSUS, *Linn. Mant.* p. 181.

One sheet, marked "Scirpus squarrosus" in Linnæus's hand is
SCIRPUS SQUARROSUS, *Linn.*

Scirpus squarrosus, Linn., is (altogether) GOOD.

SCIRPUS INTRICATUS, *Linn. Mant.* p. 182.

One sheet, marked *first* "Cyperus squarrosus" in Linnæus's hand, but this struck out and "Scirpus intricatus" substituted, also in Linnæus's hand, is

CYPERUS ARISTATUS, *Rottb.*

Scirpus intricatus, Linn., is accordingly placed as a synonym under CYPERUS ARISTATUS, *Rottb.*

SCIRPUS CILIARIS, *Linn. Mant.* p. 182.

One sheet, two plants, marked "Scirpus ciliaris" in Linnæus's hand, are FUIRENA GLOMERATA, *Lam.*

A third plant on this sheet, separately marked in Linnæus's hand as "Sc. intricatus," is so, i. e. *Cyperus aristatus,* Rottb.

Scirpus ciliaris, Linn., is placed as a synonym under FUIRENA GLOMERATA, *Lam.*

SCIRPUS HOTTENTOTUS, *Linn. Mant.* p. 182.

One sheet, marked "Scirpus hottentotus" in Linnæus's hand, is

FUIRENA HIRTA, *Vahl.*

Scirpus hottentotus, Linn., is placed as a synonym under FUIRENA HIRTA, *Vahl.*

SCIRPUS ANTARCTICUS, *Linn. Mant.* p. 181.

There are two sheets, viz.:—A, marked "Scirpus Antarcticus" in Linnæus's hand, is *Isolepis heslerioides*, Kunth, which Boeckeler regards (I think rightly) as only the full form of *Isolepis cartilaginea,* R. Br. = *Scirpus Bergianus,* Spreng.

The description of Linnæus agrees: I therefore take up for this species, so abundant in the Southern Hemisphere, the name

SCIRPUS ANTARCTICUS, *Linn.*

B, the second sheet, marked "Scirpus Antarcticus" in Linnæus's hand, is *Bulbostylis barbata,* Kunth. This plant appears anciently to have been distributed as *Sc. antarcticus.*

SCIRPUS CEPHALOTES, *Sp. Pl.* ed. 2, p. 76, n. 27.

One sheet, marked "Scirpus cephalotes" in Linnæus's hand, is

RYNCHOSPORA CEPHALOTES, *Vahl.*

The description and citation of P. Browne agree. I cite *Scirpus cephalotes,* Linn., as a synonym under RYNCHOSPORA CEPHALOTES, *Vahl.*

ERIOPHORUM VAGINATUM, *Sp. Pl.* ed. 1, p. 52, n. 1.

One sheet, marked "vaginatum" in Linnæus's hand, is

ERIOPHORUM VAGINATUM, *Linn.*

The figure cited, Scheuchz. Agrost. t. 7. fig. 1, may do; but avails little.

Eriophorum vaginatum, Linn., is (altogether) GOOD.

ERIOPHORUM POLYSTACHION, *Sp. Pl.* ed. 1, p. 52, n. 2.

One sheet, marked "polystachyon" in Linnæus's hand, is

ERIOPHORUM ANGUSTIFOLIUM, *Roth.*

The species of Linnæus, *E. polystachion*, has been divided into three very closely allied European species, of which *E. angustifolium,* Roth, is the most plentiful. It is very difficult to maintain the distinction between the three on North-American material. Under these data, the proper plan would appear to be to retain the Linnæan name *E. polystachion* for the mass of the species (*E. angustifolium,* Roth), and to call the two subspecies *E. gracile*, Koch, and *E. latifolium,* Hoppe. Unfortunately a considerable number of botanists prefer to apply the name *E. polystachion*, Linn., to the subspecies *E. latifolium,* Hoppe. This being so, botanists appear agreed, by a very large majority, to drop the Linnæan name; it cannot be applied to the prevalent form without the explanatory addition of *E. angustifolium*, Koch.

ERIOPHORUM VIRGINICUM, *Sp. Pl.* ed. 1, p. 52, n. 3.

One sheet, marked "virginicum" in Linnæus's hand, is

ERIOPHORUM VIRGINICUM, *Linn.*

The plates cited, Pluk. Alm. t. 299. fig. 4, and Morison, Hist. sect. 8, t. 9. fig. 2, are both right.

Eriophorum virginicum, Linn., is (altogether) GOOD.

ERIOPHORUM ALPINUM, *Sp. Pl.* ed. 1, p. 53, n. 4.

One sheet, marked "4. alpinum" in Linnæus's hand, is

ERIOPHORUM ALPINUM, *Linn.*

The plate cited, Scheuchz. Agrost. t. 7. fig. 4, may be right, but avails nothing.

Eriophorum alpinum, Linn., is (altogether) GOOD.

[In the discussion which followed the reading of this paper, I was convinced by Mr. Carruthers and Mr. Daydon Jackson that the common plan of citing "SCHŒNUS, Linn. *partim* (or *emend.*)" must be retained; though the meaning cannot be understood without the addition "Benth. Fl. Austral. vii. p. 352." Also, Mr. Carruthers has since showed me the plant in the British Museum whence Sloane, Jamaica, t. 74. fig. 1, is taken; this plant is *Cyperus ferax*, L. C. Rich. (a species which, I fear, we are bound to call *Mariscus Pohlianus*, Nees, if we place it in the genus *Mariscus*). Sloane's plate is so badly engraved (from the drawing prepared for it) that I am not at all surprised that I was confident that it was *not* taken from *Mariscus Pohlianus.*—C. B. C., 17th Sept., 1894.]

On the Cause of the Fall of the Corolla in *Verbascum*. By Signor U. MARTELLI. (Communicated by the President.)

[Read 7th December, 1893.]

IT is generally known that if a plant of *Verbascum* (it is presumably the same with every species) be struck smartly, the corollas already expanded will, after a minute or two, fall like a shower of leaves. This curious phenomenon, though well known, does not seem to have attracted the notice of the older botanists; and I do not know of any old author who mentions this subject. Even so accurate an investigator as P. A. Micheli has made no mention of it, either in his published work or manuscripts *. Sir J. E. Smith seems to have been the first to write about it, in his 'English Flora' (1824), vol. i. p. 311, where, after having described *Verbascum pulverulentum*, Vill., he says:—"If the stem of *V. pulverulentum* be smartly struck three or four times with a stick, all the flowers then open will, in a few minutes, throw off their corolla, the calyx closing round the germen, so that after eight or ten minutes none will remain on the plant." Charles Darwin, in his classical work, 'Forms of Flowers' (p. 78), refers to the phenomenon in the following terms:—"It is known that many species of *Verbascum*, when the stem is jarred or struck by a stick, cast off their flowers. This occurs with *V. Thapsus*, as I have repeatedly observed. The corolla first separates from its attachment, and then the sepals spontaneously bend inwards so as to clasp the ovarium, pushing off the corolla by their movement in the course of two or three minutes. Nothing of this kind takes place with young, barely expanded flowers. With *Verbascum Lychnitis* and, as I believe, *V. phœniceum*, the corolla is not cast off, however often and severely the stem may be struck."

My observations do not precisely correspond with those of Mr. Darwin. I have cultivated, and sought out wild in the country, many plants of *Verbascum Lychnitis*, on which I have continuously made experiments, and have always noticed that if you strike the stem, the corollas fall off as in *Verbascum Thapsus* and many other species. I asked several friends to make this experiment at different seasons of the year, and their experience has confirmed my opinion.

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* These lie still unpublished in the Florentine Botanical Museum.

Besides the above meagre information, I may mention that M. Maury* attributes the falling of the corollas to traumatic action, and considers it one of the means (only secondary, in my opinion) for assisting fertilization.

Observations on this subject, therefore, are by no means numerous; and Darwin's statement is the only one which illustrates the phenomenon. For this reason I have thought that it would be of interest to publish the observations which I have made during the last two summers in order to satisfy myself as to the cause of the fall of the corollas in these plants.

The phenomenon, without doubt, is to be ascribed to irritability, which is transmitted by the vascular bundles in an ascending line till it reaches the flower. In fact, if we gently strike one of the branches in the middle part, only the flowers will fall which grow above the place which has received the blow. Sir J. E. Smith and Darwin noted that the perfectly open corollas fall a few minutes after the shock given to the plant; and if this really happens, we must add that (at least in *Verbascum Lychnitis*, *Blattaria*, *floccosum*, *sinuatum*, *garganicum*, *phlomoides*, *crassifolium*, and in several of their forms and varieties), if the experiment be made in the early morning—say between 5 A.M. and 8 A.M.—the corollas only just opened (that is to say, when the sun rises) remain on the plant apparently insensible; but if the experiment be repeated in the afternoon, or on the following morning, not one of those corollas will remain on the plant. It is therefore, I think, to be inferred that some time is necessary after the expansion of the flowers before the tissues of the corollas are in a favourable condition to permit the corollas falling off in this manner.

I. *Of the Tissues of the Corolla.*

We will first examine *Verbascum Blattaria*, a common plant which grows in open grassy places, selecting a fully expanded flower which has already been open for some hours; and to prevent the corolla detaching itself from its calyx, we imbed it in glycerine-soap; we then cut a microscopical section of the part of the corolla which connects it to the thalamus.

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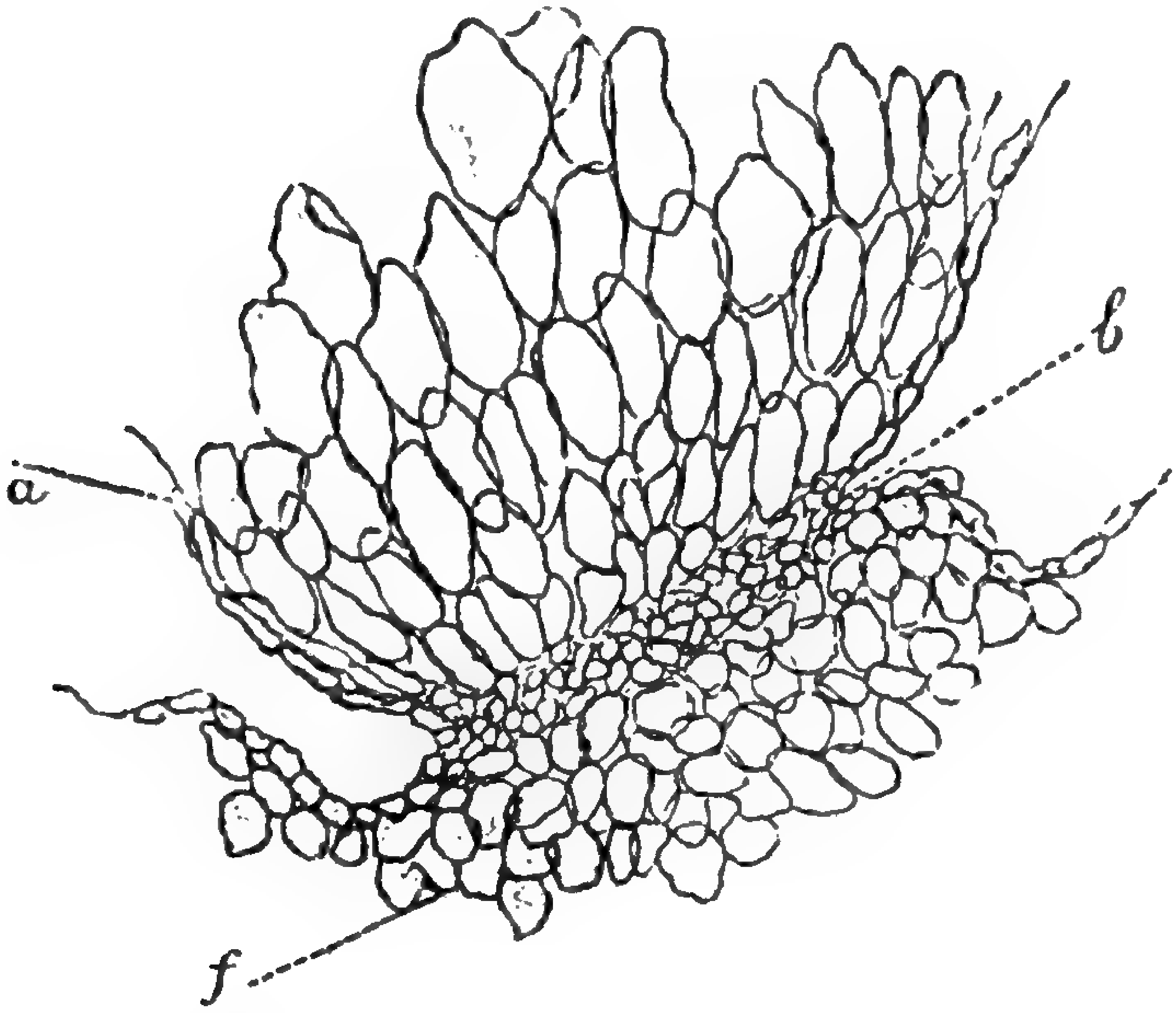
* Maury, "Observations sur la Pollinisation et Fécondation des *Verbascum*,' Bull. Soc. Bot. France, 1885, p. 53 .

The tissues of the corolla are formed, in the lower part, of ovate or oblong, large, rather irregularly shaped cells, which contain a few small grains of starch (fig. 1, *a*). The cells gradually become

Fig. 1.



narrower and longer, and the presence of the starch augments in the cells of the short tube of the corolla. The thalamus is also composed of large round cells, though they are different in shape from those of the corolla (fig. 1, *f*). But where the corolla is inserted in the thalamus it is easy to observe a zone of a few rows of opaque, slightly yellow-coloured, and minutely granular cells (fig. 1, *b*). These rows of cells constitute a stratum which distinctly divides the tissue of the thalamus from the overlying one of the corolla. This stratum forms the separating zone, by the aid of which the corolla easily detaches itself from the thalamus. Also in the leaves an identical structure is found, which in like manner brings about their fall *.

In the fully expanded flower the tissue of the corolla and of the thalamus which is nearest to the separating zone, when treated with chloriodide of zinc, turns blue, while the separating zone assumes a more or less yellow tint, scarcely visible towards the centre. If we make use of iodine, the separating zone assumes a dark yellow colour. With fuchsin or iodine-green, even after many washings this tissue retains a beautiful red or green tint. On the other hand, if a section of a flower is treated with chloriodide of zinc, the tissue of the corolla assumes a rather deep blue colour, the separating zone a light yellow tending to a green tint, and the underlying tissue of the thalamus remains uncoloured.

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* Mohl, H., "Ueber die anatomischen Veränderungen des Blattgelenkes, welche das Abfallen der Blätter herbeiführen," Botanische Zeitung, xviii. pp. 1–9 (1860). Van Tieghem et L. Guignard, "Observations sur le Mécanisme de la Chute des Feuilles," Bull. Soc. Bot. France, 1882, p. 312.

The severance of the corolla from the thalamus occurs between the last row of cells of the separating zone and those of the corolla (fig. 1, *b*). Therefore the stratum of small cells, of which we have already spoken, remains adherent to the thalamus, as will be easily seen by dividing the two parts—that is, the corolla from the calyx—or by examining the thalamus just when the corolla has fallen off; the adherent tissue, which formed a part of the separating zone, dwindles and gradually disappears almost entirely.

We will now refer to its antecedent condition, and take into consideration a flower still in the bud. The separating zone at this epoch is already visible, and the tissue appears opaque and of a yellowish colour: the chemical reactions obtained have already been noticed above. As to size, the cells of the separating zones are very little different from those of the corolla and of the thalamus, though smaller, but they have a pentagonal shape. Little by little, as the flower develops, the tissue of the separating zone assumes more of its character, the cells subdivide, their shape is modified, becoming gradually rounder in form. This variation of shape is, I consider, very important in the phenomenon of the fall of the corolla which we are considering, because, owing to this change, the corolla acquires less power of cohesion to the thalamus, as I will hereafter explain.

II. *On the Fall of the Corolla.*

The power of resistance possessed by the flower when only in the bud-stage, or but just expanded, is, in my opinion, explained by the cohesion of the cells of the tissue of the separating zone. In the flower still in bud these cells are pentagonal, and for this reason they form a united and compact tissue, which offers more resistance; on the other hand, in the flower which has been open some time the cells become smaller and rounder, in consequence of successive changes, for which reason the continuity and the resistance of this tissue diminishes.

Thus, under these circumstances, even a very little effort will occasion the separation of the cells. So that, in consequence of the irritating action caused by a stroke given to the plant, the sepals at once rise up, becoming connivent, and by this movement they press against the corolla, which, by the decreased cohesion of the cells of the separating zone, easily separates and is thrown off. But, to explain this phenomenon more clearly, let us divide it into two periods, and consider the sepals as consisting of two parts—the base and the lamina. In the first period it is the base of the sepal which acts, and closes against the corolla in such a way that it compresses the base of the corolla, and obliges it to slide forward, and thereby separates it from the thalamus. By paying close attention to this period, we perceive in the corolla at first a slow forward movement, which probably corresponds to the separation of the cells of the separating zone, and in the second place a slighter, but at the same time abrupt movement of the corolla, which certainly happens when the vascular bundles break. During the second period the lamina of the sepal rises, with a more or less rapid movement, and, leaning against the corolla and compressing it, pushes it continually forward until, owing to its weight, it gradually falls off. Then the sepals continue the converging movement till they completely enclose the ovary *.

In the same way, the base of the small tube of the corolla seems to me to have a structure which facilitates the expulsive action of the calyx. This is the way that *Verbascum Blattaria* is formed:—In the lower and external part of the tube of the corolla we notice an unexpected swelling, with a pentagonal outline, almost as if it were a protruding ring (fig. 2, *a*). From the external border of this ring to the circular orifice of the corolla, the very short part of the tube (fig. 2, *b*) is very smooth, and appears as if varnished. Owing to the above-mentioned phenomenon of irritability produced by a stroke given to the plant, the base of the sepals, contracting itself as we have already stated, presses against the annular projection; and, owing to its inclined position, the corolla is pushed forward and forced from the thalamus. In *Verbascum sinuatum*, as in some other species, the annular projection does not exist, but instead, towards the base, the tube of the corolla is rather swollen (fig. 3, *c*), and thence to as far as the orifice it ends in an inclined plane.

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* In some species, as for instance in *Verbascum floccosum* and *Verbascum sinuatum*, when the corolla has fallen, the sepals become at once connivent with a rapid movement. In other species, as for instance in *Verbascum Blattaria*, this movement is slower, and some time is necessary before the sepals assume their final decisive position—that is to say, perfectly connivent. I have also severed the sepals, so as to ascertain their expulsive action; but I cannot add anything to what I have already said, unless it be that they have confirmed me still more in the opinions expressed.

Fig. 2

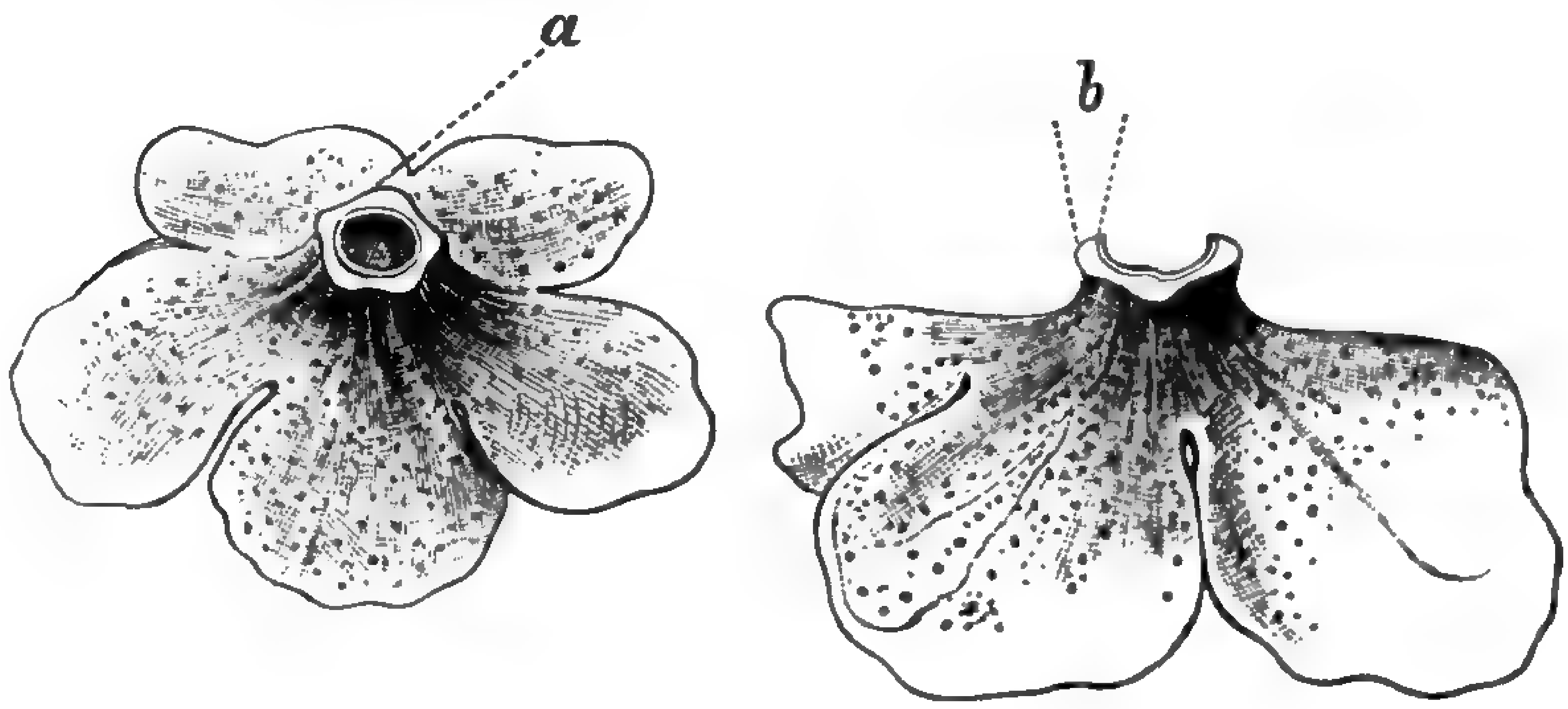
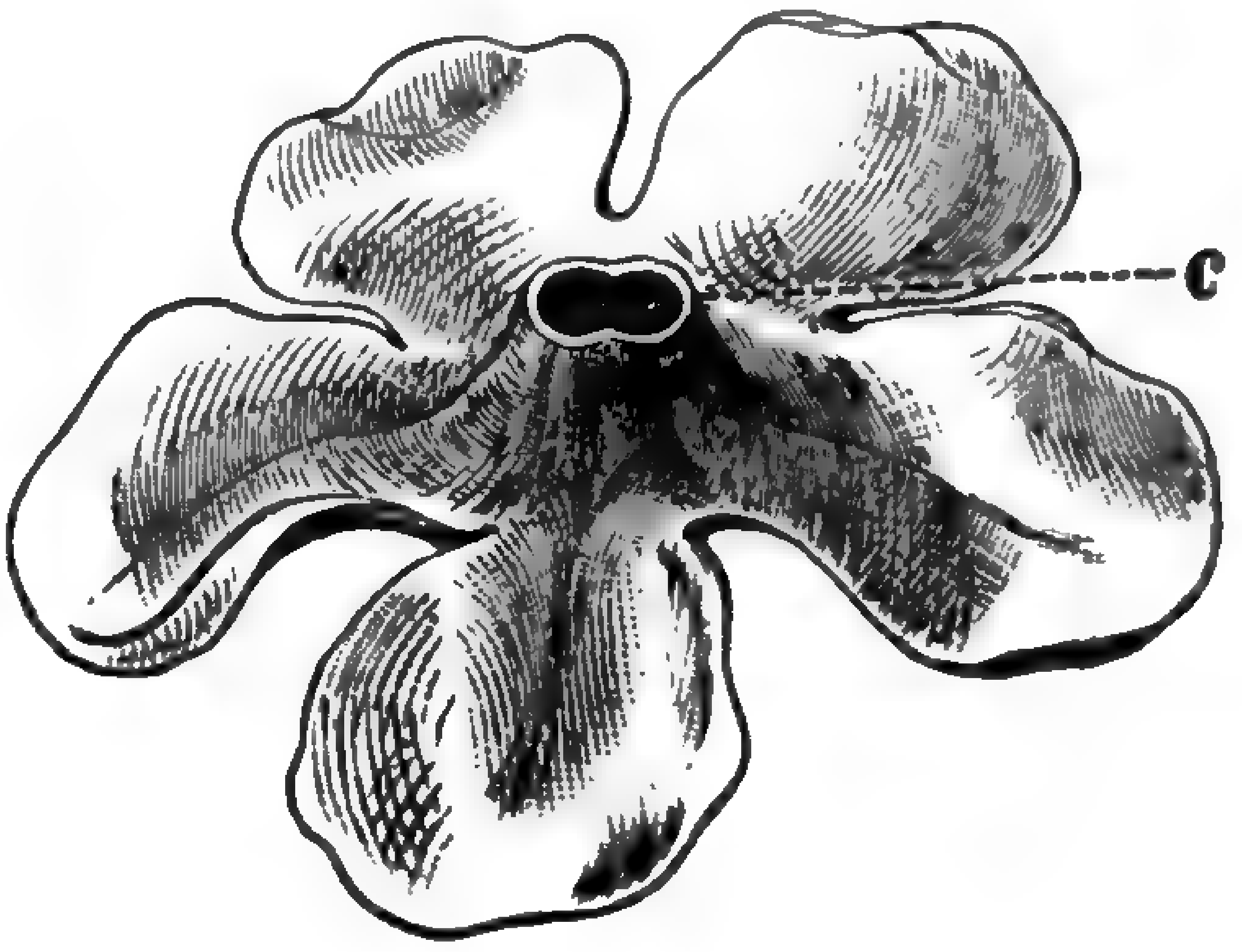


Fig. 3.



Besides this special structure of the base of the corolla, we must not leave unnoticed another kind of structure which is very important—namely, glabrescence or smoothness (almost amounting to polish)—which the lower and external part of the base of the corolla, covered by the sepals, presents to us. All this greatly facilitates the sliding of the sepals on the sides of the corolla, which is generally covered with hairs, often plentiful and sometimes stellate.

Having set forth these facts, it is easy to see that my observations and conclusions do not entirely agree with those expressed by Darwin *. He is of opinion that the corolla first separates itself from the thalamus, and that afterwards the sepals push it off. This opinion would admit of a spontaneous action of the corolla in detaching itself from the thalamus; while I believe that the fall of this organ is subject to the effort exercised by the sepals, and especially by the basal part of them. The separating zone, which is not mentioned by Darwin, has not, I believe, at this moment and in this case, any other action than that of diminishing the resistance of the tissue. It may, however, have another function, namely, that of assisting the normal detachment of the corolla from the thalamus.

I would further add that, in order that the irritability of the sepals should produce its effect on the corolla, it is necessary that the tissues of the flowers should be in a state of turgescence. In fact, if we place some cut branches of *Verbascum* in water, during the first and second day we may notice that its flowers are always sensitive to shocks, but that, little by little, this sensitiveness diminishes, and the new flowers do not suffer from any blow aimed at the branch.

In conclusion I may state that I should liked to have examined more species of *Verbascum*, so as to ascertain whether the phenomenon is common to all the species, as I believe to be the case, but have not had opportunities of so doing. The species on which I have experimented are:—*Verbascum Blattaria*, *Cedreti*, *crassifolium*, *floccosum*, *garganicum*, *Lychnitis*, *longifolium*, *macrurum*, *montanum*, *nigrum*, *niveum*, *orientale*, *phœniceum*, *phlomoides*, *pulverulentum*, *sinuatum*, *Thapsus*, *thapsiforme*, *virgatum*, and many of their forms and varieties. In all these I have noticed the same phenomenon. If even other species do not obey this law, the anatomical study of these would certainly be interesting, and might serve as a guide and a comparison for later and more decisive results.

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* Darwin, 'Forms of Flowers,' p. 78.

On the Habits of *Lemna minor*, *L. gibba*, and *L. polyrrhiza*. By H. B. GUPPY, M.B. (Communicated by W. BOTTING HEMSLEY, F.R.S., A.L.S.)

[Read 3rd May, 1894.]

AFTER three years' systematic observations of these plants *, I find that in this branch of the subject my notes add but little to what Hegelmaier recorded about a quarter of a century ago in his general work on the Lemnaceæ. Though that work is concerned chiefly with their structural characters, it cannot easily be supplemented now without a great amount of observation and experiment based on new lines of research.

These plants at first sight seem well fitted for an inquiry into their adaptation to the conditions of their existence; and Professor Miall, in an interesting lecture at the Royal Institution in March, 1892, treated of some of their relations to the physical characters of water. Eminently suited as the duckweeds are for aquatic life, it is a little perplexing that they will thrive just as well on wet mud.

For twenty months I have cultivated *Lemna minor* on wet mud, where it throve and budded all the seasons of the year. To give an instance, two plants set apart in October had increased to twenty by April, and to fifty by the next October. Nor has this long exposure to different habits of life produced any permanent change in the characters of the plants so far as their external appearance is concerned. After a culture of twenty months on the mud the plants still float on water and retain their root-caps, even in cases where the roots have penetrated a line or two into the soft mud. The winter fronds of *Lemna polyrrhiza*, also, when placed on wet mud in the spring, bud freely, and in the course of a few weeks produce the summer form of the plant. Duckweed stranded on the mud during the drought of the summer of 1893 remained alive most of the season wherever the earth around the ditch or pond remained moist. *Lemna minor* is to be observed flourishing on the wet soil and oozy ground in the vicinity of springs some feet above the level of the pool beneath; and here it can safely withstand the longest drought. It is conceivable that during changes of climate the Lemnæ might long find a refuge in the vicinity of perennial springs.

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* In the South-east of England, in Epping Forest and around Kingston, and in the rivers Thames and Lea.

Coming to the individual species, I will first refer to *Lemna gibba*. The plants with gibbous fronds as a rule die long before the winter, and new plants similar in form appear in April or May. Now and then, however, in mid-winter, a few healthy gibbous plants are to be found in ditches, ponds, and rivers, which bud freely in the spring. A number of plants, kept through the winter of 1892-93 in a room without artificial heat, retained their buoyancy and gibbous form, and were quite healthy when they budded in the spring. The temperature of the water was for some weeks under 40° Fahr., and for ten consecutive days it was under 36°, the plants being inclosed in ice for a day or two. Evidently, therefore, low temperature is not of itself injurious to the gibbous plants; and since, as shown below, they die in numbers in the tepid water of August after flowering in July, their death before winter is due to the exhaustion of their vitality and not to the fall of temperature.

Assuming that this plant is sometimes able and at other times unable to float through the winter in the gibbous form, it becomes a question, when the plants disappear in the autumn, whether the new plants in the spring are produced from seed, or whether, as in the case of *Lemna polyrrhiza*, there is a special winter form. Hegelmaier inclined to the latter view in the text of his work (page 64), and although the winter form of the plant had, in a sense, escaped his observation, in his supplement he welcomed the discovery of Dr. van Horen in this respect. The following notes bear on this matter :—

In the first week of July, 1893, I found in the almost stagnant water of a ditch, connecting the Diana Pond with the other large ponds in Bushey Park, a truly enormous quantity of *Lemna gibba*, abundantly in flower, and mixed with a large amount of separate thin flat fronds, just like those of *Lemna minor*, and also in flower. Mingled with them were a great number of the plants of *Lemna polyrrhiza*, not in flower, but producing the winter fronds to an extent I have never seen before or since. Beneath the floating mass of duckweed, which was two or three inches thick, flourished *Lemna trisulca*, but not in flower. The temperature of the surface of the ditch in the afternoon of July 7th was 87° Fahr., and at the bottom, eight inches down, it was 82°. From the run of my series of freshwater temperatures, then in progress, it is to be inferred that during the few weeks preceding the flowering, the surface must have been frequently heated to 80° in the daytime, the nocturnal fall of temperature being about half that of the air. Such were the thermal conditions under which *Lemna gibba* flowered.

Under a lens the gibbous plants had the appearance of producing female flowers, and the separate thin flat fronds male flowers, which was due to the circumstance of the pistil alone protruding in the one case, and of the stamens, usually two in number, alone showing in the other, although in both instances the flowers were hermaphrodite. After several visits to the ditch, only one or two rare exceptions to this rule were found, namely, where the gibbous plants had evolved stamens. It seemed, therefore, as if the flowers were functionally unisexual. However, no plants in the fruiting-stage came subsequently to my notice. Under observation at home, the flat fronds were produced by budding by the gibbous plants, the process being rapid, and their stamens visible through their substance before they floated away.

The flowering period covered the greater part of July. During August the gibbous plants produced abundantly thin and flat fronds, which were now flowerless and of a dark green hue. These new fronds presented a great contrast in colour to that of the mother plants, had in each case a single root, and showed the three distinct nerves which, according to Hegelmaier, characterize the flatter forms of *Lemna gibba*. Such proved to be the winter plants, and, as in the case of *Lemna polyrrhiza*, they were extensively produced in summer. Their appearance in August was accompanied by the death of a large number of the gibbous mother plants, both in the ditch and in my vessels at home, a result which certainly could not have been the effect of low temperature. The remainder of the gibbous plants proceeded actively with the development of winter fronds during September and October, and it was not until early in November that the characteristic forms of the plant had disappeared. At this time their dark green flat offspring were budding freely, both in the ditch and at home, some at the surface and some at the bottom; but those afloat could always be sunk by a touch: and, in fact, it was not until March that the winter plants could float independently, though many of them remained at the surface owing to their power of repelling water after being floated up by bubbles. As the winter advanced, the fronds lost their dark hue and the distinctness of their nerves; and after the beginning of the year the plants could not, in general form and appearance, be distinguished from those of *Lemna minor*. Budding, which had been suspended during the winter, began briskly early in February, similar fronds being produced; but up to the fourth week of April they exhibited only a slight sponginess in appearance, and would have been taken for vigorous forms of *Lemna minor*. Up to the time of writing, it was evident from the temperature observations made at the ditch and in my vessels, that for the development of the gibbous character the winter plants require, for a week or more, an average daily maximum temperature at the surface of the water of not much, if at all, under 70° Fahr.

It would seem from the above that the form in which *Lemna gibba* passes the winter in this climate depends a good deal on the thermal conditions of the locality it frequents in summer. Where the water is cool and there is little or no surface-heating, as in a spring-fed brook or in a river, the gibbous plants would never flower and probably also would not develop special winter plants, but would float unimpaired through the winter. In the warm and stagnant water of a shallow ditch the plants would most often flower; but the flowering process, by exhausting their vitality, would result in the intervention of a peculiar winter form. That the intervention of a special winter form depends indirectly on a high summer temperature seems a little paradoxical; but my temperature observations indicate that there is much to learn about the habits of this plant.

Lemna polyrrhiza, like *Lemna gibba*, has a winter form, but the resemblance there ends. Whilst with *Lemna gibba* the winter fronds, after detachment, bud in the autumn and pass the winter as complete plants, which attain in the spring the peculiar gibbous form, with *Lemna polyrrhiza* the winter frond remains solitary and produces, by budding, the summer plant without ultimately becoming incorporated with it. When the winter frond of *Lemna polyrrhiza* has performed its office, it becomes sickly, sinks, and dies.

The description of the solitary, dark green, reniform, and rootless fronds that enable *Lemna polyrrhiza* to pass the winter in this climate without seeding, will be found in Hegelmaier's work. As pointed out there, though destined for the winter, they are largely produced in summer, and, as before remarked, they never came under my notice growing in such numbers from the mother plant as in the first week of July in the tepid water of a stagnant ditch where *Lemna gibba* was in flower. This budding process goes on until about the end of October, when the summer plants all die. My temperature observations during the autumns of 1892 and 1893 on the Thames above Kingston and on several ponds in that neighbourhood, all plainly indicate that when the surface temperature in the day falls short of 50° Fahr. rapid decay and death of the summer plants ensue.

The winter fronds of *Lemna polyrrhiza*, when first detached, nearly always sink; but occasionally they cannot be sunk, such fronds being rather thicker than the average. Whilst some pass the winter afloat, others spend it at the bottom. Hegelmaier speaks of them as all remaining under water; but they vary much in this respect with the character of the weather at the time of their growth, and with the other conditions under which they are developed. They are to be found constantly in winter amongst the floating seed-drift of the rivers Lea and Thames, and of the ponds around Kingston; and through the past winter they floated in great numbers on one of the Home Park ponds. In a fine calm autumn with plenty of sunshine, the sunken winter fronds in the shallow water are very liable to be floated up by air-bubbles, and they acquire independent floating powers at the surface. In such weather, also, the mother plants die slowly, and their winter offspring remain sufficiently long attached to be able to float of themselves. On the other hand, in rainy and windy autumns the disturbance of the surface of the water brings about the detachment of the winter fronds before they can float, and they all go to the bottom.

During two winters I have kept under observation both the winter fronds that could not be sunk, and those that remained at the bottom. Various agencies assist in floating up the sunken fronds in spring. When exposed in a clean glass vessel to moderate sunshine, they are carried up by bubbles of their own forming, and, throwing off the water, they emerge at the surface. For the first few days they can always be sunk at a touch, but after that they float of themselves. Without the sun, these fronds usually remain at the bottom, become sickly, and die. Those that have remained under water all the winter are able to throw off the water from the first, and do not acquire this power at the surface. If there is any impediment to rising, the sunken fronds begin to bud at the bottom, and through the buoyancy thus obtained they sooner or later appear on the top. Usually, however, the sunken winter frond is independent of its own efforts in floating up. The bubbles, evolved in quantity through the excitement of vegetable activity on the mud of the pond, carry them up in numbers, and once at the surface their power of throwing off the water keeps them afloat, and in calm dry weather they will, in a few days, acquire independent buoyancy.

The time when the winter fronds of *Lemna polyrrhiza* begin active budding is generally in April; but this is mainly determined by the temperature of the water, and though the amount of sunshine received is the same, the fronds in the shallows will always be more advanced in the growth of the summer plants than those in the cooler and deeper water.

In considering the temperature at which the winter fronds begin to bud into the summer plants, it is as well to remember that an estimate of the initial temperature of budding or of germination of a water plant, to be of any practical value, should be brought into some kind of relation with the thermal *régime* of a ditch, pond, or river *. This subject can only be touched upon here. Rivers, on account of their lack of surface-heating, their small daily range of only one or two degrees (Fahr.), and their comparatively uniform rise of temperature with the advance of spring, afford very valuable opportunities of ascertaining the temperature of budding or germination of floating plants or seeds. Here a single forenoon observation gives the day's mean temperature. With ponds we get the disturbing influence of daily range, not very marked it is true; in the centre of a pond it would be only five or six degrees, but considerable at the margin, where it would amount to some twelve or more degrees. A comparison of the daily mean temperatures of a river and a pond is, therefore, theoretically open to objection; but in practice inconsistent results are not obtained.

From my Thames observations I estimated the initial temperature of active budding in the river, in the case of the winter fronds of *Lemna polyrrhiza*, at about 55° Fahr., sometimes more and sometimes less, this being the mean temperature of the week preceding the budding. Imitating at home the thermal conditions of the central parts of a pond with a daily range of five or six degrees, my estimates of two different years were 51° and 53°. Observations in the shallow water of a pond, where the range is more than twice as large, gave me estimates of between 53° and 54° as the mean temperature of the preceding week. It will thus be seen that the results obtained are much the same whether in the shallows or centre of a pond, or in a river.

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* I am dealing with this subject in a series of papers, of which the first was read before the Royal Physical Society of Edinburgh in January.

Since, however, it is at the margins of ponds that these winter fronds gather in the spring, I will deal more particularly with this part of a pond, not only as regards the daily mean temperatures, but also with regard to the run of the daily maximum temperatures. When, as is usual at the beginning of April, the temperature of the water rises to 60° in the day, and the daily mean is 53° or 54°, the winter fronds commence to bud briskly. When the daily maximum rises to 65°, the summer plants are half developed. When it rises usually to 70°, as happens in May, the fully-formed plants abound: this represents a daily mean of 62° or 63°, and it is noteworthy that it is not until the temperature of the river Thames reaches 60° that the summer plants are found on its waters, the river lending its testimony to the evidence of the pond.

Coming to *Lemna minor*, my notes contain nothing that in any way supplements Hegelmaier's description of their habits. During three winters, both at home and in the ponds, they have floated to the spring. In three successive springs in my greenhouse, they began to bud many weeks before the winter fronds of *Lemna polyrrhiza*, in the same vessel, showed signs of commencing. At the margin of a pond they begin to bud actively when the mean maximum temperature of the water for a week reaches 45°, which represents a mean temperature of about 40° for that period.

The seeds came under my notice in February 1891 and 1894, floating amongst the seed-drift of ditches, ponds, and rivers, subsequently germinating at the surface, and producing the typical plant. On February 2nd of this year there were a few seeds germinating in a pond where I was recording the temperature, an observation which enables me to say that the thermal conditions requisite for germination are the same as above given for the budding of the fronds in early spring. The budding and germination were going on side by side in the same pond.

Estimates of Pond and Ditch Temperature for the week preceding Germination, etc. (Fahr. scale).

Obs.	Species.	Date.	Mean Temp.	Average Max. Temp.
Germination.	*L. minor* *.	Early in Febr.	40°	45°
Budding in spring.	*L. minor.*	Early in Febr.	40°	45°
"	*L. gibba.*	Febr.	45–46°	51°
"	*L. polyrrhiza.*	Early in April.	52–53°	60°
Full development of the summer plant.	*L. gibba.*	May.	61–62°	69–70°
	L. polyrrhiza.	May.	62–63°	70°
Flowering.	*L. minor.*	June.	65°	72–73°
"	*L. gibba.*	July.	73°	80°
Death of the summer plant.	*L. polyrrhiza.*	End of October or early in Nov.	...	Under 50°

* In a previous spring the seeds of *Lemna minor* germinated at the latter part of February, but no temperatures were recorded. Mr. W. Wilson (Hooker's Botan. Miscell. vol. i. p. 145) regards April as the usual time for the germination of the seeds of *Lemna gibba*, but he experimented on some which had been kept dry throughout the winter.

Note, *Sept.* 12*th*, 1894.—I have since learned that Micheli described the flowering of *Lemna gibba* in language similar to my own (Journ. de Phys. tome 82, p. 107). This plant has behaved very differently during the cool and unsettled weather of the past summer. The gibbous fronds did not appear until early in July, and very few flowered, showing only the pistil, as before. No winter flat fronds have been developed. A recent experiment has proved that *Lemna polyrrhiza* is able to go through all its stages of growth on wet mud. Winter fronds placed on wet mud in March gave rise to the characteristic summer plants, which in their turn are now producing the winter fronds.—H. B. G.

HEPATICÆ ELLIOTTIANÆ, insulis Antillanis S^{ti} Vincentii et Dominica a clar. W. R. Elliott, annis 1891–92, lectæ, RICARDO SPRUCE determinatæ.

[Read 21st December, 1893.]

(PLATES XX.–XXX.)

THE new species in the following list of the Hepatics collected by Mr. W. R. Elliott in the British West Indies during the years 1891 and 1892, on behalf of the Joint Committee of the Royal Society and the British Association for the Exploration of the Natural History of the West Indies, seem not to have been described before. In some of the finest and most conspicuous species of his gathering he had been anticipated by Eggers, Wallis, and others, who had previously found them in other isles of the Antilles, or on the mainland of S. America, in Venezuela and New Granada. Good descriptions of them have been given by Herr Stephani in the pages of 'Hedwigia' for the years 1888 and 1892. Those here described are mostly minute species and include no novel types, but are some of them interesting as adding new forms to groups of which only a few species were previously known.

Since the publication of Swartz's 'Flora Indiæ Occidentalis,' vol. iii. (1806), where several West-Indian hepatics were described for the first time, and often very incompletely, with some confusion of allied forms under the same name, there has been no attempt at a complete hepatic flora of the whole group. The only island which has been systematically explored for hepatics is Porto Rico, where the Kunstgärtner C. Schwanecke gathered them during three years (1847–50); and his specimens, comprising 58 species, were published by Hampe and Gottsche in 'Linnæa' for 1853 (pp. 333–357). Nearly 40 years later (1885–7) Sintenis added largely to this total, and Stephani's enumeration of the entire hepatic flora amounts to 111 species ('Hedwigia,' 1888, pp. 276–302). In 1845 Montagne described the few Cuban hepatics known to him in Ramon de la Sagra's 'Historia fisica . . . . de la Isla de Cuba,' vol. ix. 1845, and was able to give for the first time a figure of the perfect plant of the curious *Cyathodium cavernarum*. I also gathered this plant, but sterile, in a cave at the foot of the volcano Tunguragua in Ecuador, but inadvertently omitted it from my enumeration, "Hepaticæ Amazonicæ et Andinæ," in Trans. Bot. Soc. Edinb. xv. (1884).

[At this point the MS. of Mr. Spruce's preface abruptly ends, and within two or three days after he wrote these last words he was taken from us. He intended no doubt to cite the chief papers that treat of the Hepatics of the West Indies; and for the benefit of those who are interested in the paper the following notes are added.

Montagne's Cuban list contained 32 species; and some years later additions to it were found among the hepatics gathered by the American traveller Charles Wright, which were named by Gottsche and distributed without numbers by Asa Gray after the collector's death in 1885. From Jamaica 38 species are recorded in H. Boswell's list in the 'Journal of Botany,' 1887, p. 49; and 4 more occur in a paper by Lindenberg and Hampe in 'Linnæa,' 1851, pp. 300, 640. From San Domingo 34 species gathered by Eggers are given by Stephani in 'Hedwigia,' 1888, p. 299, and in the same paper 6 are mentioned as coming from Dominica, 3 of which do not occur in Mr. Elliott's collections. The French Antilles—Guadeloupe and Martinique—which are the neighbouring islands to Dominica, have been searched in late years and, in M. Bescherelle's recent list in 'Journal de Botanique,' 1893, pp. 174, 183, present a total of 148 species; but they will probably prove more fruitful than this, for their united area—about 1100 sq. miles—is more than double that of Dominica and St. Vincent, which is only 415 sq. miles and yet has produced, as will be seen in the following list, 162 species, of which 30 are new, and in addition to which several other species are likely to be found by future collectors. The results which have been attained in other islands, such as Trinidad, Barbados, and St. Kitts, must be sought in the 'Synopsis Hepaticarum,' 1844–7, and in the series of monographs of genera which are being produced with such industry by Herr Stephani.

Mr. Spruce's paper has been recast so as to bring the list of species, the descriptions, and the notes into one series. The author left a number of short notes which have been expanded; but a few which were so brief as to defy interpretation have been omitted. A few extracts from his letters have been added. The drawing of the plates has been supervised, and an explanation of the figures prepared. The numbers and localities have been carefully collated with Mr. Elliott's collections and corrected where necessary, and two species which Mr. Spruce had identified but omitted to put in his list have been included. The references to published descriptions have been looked up and inserted.—A. Gepp.]

Subordo I. JUNGERMANNIACEÆ.

Tribus I. *JUBULEÆ.*

Genus 1. Frullania, *Raddi.*

Four species have been recorded from the French Antilles; and of these only one appears in Mr. Elliott's collections. This is *F. atrata*, a not uncommon plant in the mountains of nearly the whole of tropical America. In the Andes I have seen it growing in huge masses half-a-yard long.

1. F. (§ Chonanthelia) arietina, *Tayl. in Syn. Hep.* p. 413.—St. Vincent, Richmond Peak (215). Dominica, River Douce Valley (704), Shawford Estate (898).

2. F. (§ Meteoriopsis) atrata, *Nees, in Syn. Hep.* p. 463.—Dominica, Morne Trois Pitons (491), Morne Diablotin (648, 688). Var.—St. Vincent, Richmond Peak (215). Pendulous from trees.

3. F. (§ Thyopsiella) spatuliflora, *Spruce*, n. sp. (Tab. XX. figs. 1–4.)

Monoica, pusilla, prostrata, rufo-badia, caule pollicari vage sat ramoso. ***Folia*** fragilia, subplana, subdivergentia, inferiora contigua, ramia imbricata, oblique subsemiovata, rotundata, raro abrupte subacuta; ***cellulæ*** præminutæ, subpellucidæ, æqualiter incrassatæ, trigonis vix ullis; ***lobulus*** folio triplo fere brevior, cauli parallelus et subcontiguus, breviter conico-cylindricus, obtusus. ***Foliola*** foliis plus duplo breviora, pallida, tenera, appressa, oblonga, plana, ultra $\frac{1}{3}$ fissa, segmentis obtusis. ***Flores*** ♀ in caule et ramis terminales; ***bracteæ*** foliis dimidio longiores, profunde complicato-bilobæ, lobo antico oblique oblongo-rotundato, postico subminore et angustiore, lanceolato; ***bracteola*** magna, cuneato-obovata, ad $\frac{1}{2}$ biloba, complicato-carinata, lobis lanceolatis conniventibus (arte expansis divergentibus). ***Perianthia*** emersa, compresso-trigona, spatulata, supra basin obconicam fere quadrata, apice lato retuso vel subobcordato brevirostria. ***Andrœcia*** brevia, paucijuga.—***Folia*** ·4 × ·3–·35, ***lobulus*** .15, ***cellulæ*** $\frac{1}{80}$; ***foliola*** ·18 × ·12; ***bracteæ*** (***lobus***) ·6 × ·35, ***bracteola*** ·8 × ·65; ***perianthia*** 1·05 × ·8 mm.

Hab. Ad cortices in situ Laudat, ins. Dominica (Elliott, no. 857, a. 1892).—Florescentia monoica et stipulis planis, præcipue tamen forma perianthii singulari, a plerisque *Thyopsiellis* distat.

4. FRULLANIA (§ DIASTALOBA) CAULISEQUA, *Nees, in Syn. Hep.* p. 448.—St. Vincent, Wallilaboo Valley (177). Dominica, Morne Anglais (492). On bark.

5. F. (§ DIASTALOBA) SUBTILISSIMA, *Lindenb. in Syn. Hep.* p. 443.—St. Vincent, Richmond Peak (208). On bark.

Genus 2. LEJEUNEA, *Lib.*

There are 66 species in Mr. Elliott's collections; whereas 42 have been recorded from the French Antilles.

Subgenus 1. OMPHALANTHUS, *Lindenb. et Nees.*

6. LEJEUNEA FILIFORMIS, *Mont. in D'Orb. Voy. Am. Mér., Bot. Crypt.* p. 64; *Omphalanthus filiformis*, Nees, in Syn. Hep. p. 304.—Dominica, Roseau Valley (62), creeping on *Plagiochila*; Morne Micotrin (66), sine loc. (516).

Subgenus 2. STICTOLEJEUNEA, *Spruce.*

7. L. SQUAMATA, *Nees, in Syn. Hep.* p. 322.—St. Vincent, Bonhomme Valley (93). Dominica, Morne Couronne (225).

Subgenus 3. NEUROLEJEUNEA, *Spruce.*

8. L. PORTORICENSIS, *Hampe et Gottsche, in Linnæa,* XXV. (1852), p. 352.—Frustulum in *Plagiochila* carpsi.

9. L. BREUTELII, *Gottsche, in Syn. Hep.* p. 324.—Dominica, Roseau Valley (80).

Subgenus 4. BRYOPTERIS, *Nees.*

10. L. LONGISPICA, *Spruce, in Trans. Bot. Soc. Edinb.* XV. p. 114.—Dominica, Morne Diablotin (642).

Subgenus 5. ACROLEJEUNEA, *Spruce.*

11. L. TORULOSA, *Spruce, in Trans. Bot. Soc. Edinb.* XV. p. 117; *Phragmicoma torulosa*, Lehm. & Lindenb. in Syn. Hep. p. 294.—St. Vincent, Fancy farm (343).—[Mr. Spruce made a note in his MS. of the four species *Acrolejeunea atroviridis*, *torulosa*, *juliformis*, and *polycarpa*; but whether because he considered them all closely allied, I am unable to say. He told me in a letter that one of the main differences of *A. atroviridis* from its nearest ally, *A. torulosa*, is that the perianth of the latter has 7 to 9 plicæ or keels, whereas that of *A. atroviridis* has only 4—2 marginal, 2 postical.—A. G.]

12. LEJEUNEA (§ ACROLEJEUNEA) ATROVIRIDIS, *Spruce*, n. sp. (Tab. XX. figs. 5–10.)

Dioica, pusilla, late cæspitosa, sordide viridis, nigricans, in ætate sæpe aterrima; caules $\frac{1}{4}$–$\frac{1}{2}$-pollicares, e caudice procumbente ramoso orti, simplices vel parum ramosi, æquifoliati. *Folia* imbricata, patentia, subdivergentia, supra basin saccatam transverse oblonga rotundata valde recurvo-concava, medium versus sinuato-complicata, *lobulus* plus duplo brevior, turgidus, quasi-conchæformis, margine tamen planus, apice rectangulus, sæpe reclusus; *cellulæ* parvulæ, subconformes, trigonis nullis minimisve. *Foliola* plus triplo breviora, dissita, late cuneato-orbiculata reniformiave, tenuissima, cellulis minoribus subquadratis rectangulisve. *Flores* in caule, rarius in ramo, terminales; *bracteæ* foliis paulo longiores, planæ, oblique ovales obtusatæ, lobulo perparvo plano lineari vel anguste triangulari basi auctæ; *bracteola* vix brevior late obovata rotundato-truncata, libera. *Perianthia* emersa, pyriformia, sat compressa, antice subdepressa, postice altiuscule bicarinata, margine carinisque repando-scaberula.—*Folia* ·7 × ·6 (*basi*) × ·5 (*ad lobuli apicem*), *lobulus* ·3, *cellulæ* $\frac{1}{36}$; *foliola* ·2 × ·3–·35; *bracteæ* ·8 × ·5, *bracteola* ·75 × ·6; *perianthia* 1·3 × ·8 mm.

Hab. Ins. Sti. Vincentii, Richmond Valley, ad rivuli exsiccati lapides (ELLIOTT, no. 219, Febr. 1892).—Ab *Acrolejeunea torulosa*, L. et L., affini, satis diversa, perianthio præcipue solum 4-(nec 7–9-)plicato.

Subgenus 6. LOPHOLEJEUNEA, *Spruce*.

13. L. SAGRÆANA, *Mont. in Syn. Hep.* p. 314.—St. Vincent, Richmond Valley (212).

Subgenus 7. PLATYLEJEUNEA, *Spruce*.

14. L. GRANULATA, *Nees, in Syn. Hep.* p. 311.—St. Vincent, Richmond Valley (221).

15. L. VINCENTINA, *Gottsche, in Syn. Hep.* p. 313.—Dominica, Morne Diablotin (674).—This species has not been noticed among Mr. Elliott's collection from St. Vincent; nor has another species—*L. Hobsoniana*, Lindenb.—which was gathered on Mt. St. Andrews by Hobson in 1822. Stephani indicates *L. transversalis* among Eggers's gatherings in Dominica ('Hedwigia,' 1888).

Subgenus 8. ARCHILEJEUNEA, *Spruce.*

16. LEJEUNEA XANTHOCARPA, *Lehm. et Lindenb. in Syn. Hep.* p. 330.—Dominica, Morne Trois Pitons (70), Morne Couronne (231), River Douce Valley (710).—This plant, which is absent from equatorial America, occurs in Guadeloupe, Bolivia, and Africa.

Subgenus 9. BRACHIOLEJEUNEA, *Spruce.*

17. L. BICOLOR, *Mont. in D'Orb. Voy. Am. Mér., Bot. Crypt.* p. 349; *Phragmicoma bicolor*, Nees, in Syn. Hep. p. 294.—St. Vincent, Fancy farm (343).

Subgenus 10. HOMALOLEJEUNEA, *Spruce.*

18. L. BRACHIATA, *Nees, in Syn. Hep.* p. 313; *Phragmicoma Guilleminiana*, Nees et Mont. in Syn. Hep. p. 293.—St. Vincent, Richmond Peak (210). Dominica, Morne Trois Pitons (764).

Subgenus 11. ODONTOLEJEUNEA, *Spruce.*

19. L. LUNULATA, *Nees, in Syn. Hep.* p. 326.—Dominica, Morne Couronne (233), Morne Trois Pitons (760).

20. L. CHÆROPHYLLA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 147; var. PAROICA.—St. Vincent, Mt. St. Andrews (146), Richmond Peak (356). Dominica, sine loc. (516). In foliis vivis.

In the S. American plant described by me (*op. cit.* p. 147) the inflorescence is monoicous (autoicous), the male organs being contained in separate branches from the female. But in the St. Vincent plant similar male branches have a female flower in the terminal bud, which is often fertile, thus constituting a paroicous inflorescence. As I can find no other difference whatever, I must refer both forms to a single heteroicous species.

Herr Stephani has lately referred this plant to *L. Sieberiana*, Gottsch., a Mauritian species, described in 'Synopsis Hepatic.' p. 328, with "foliis margine supero apiceque minute serrato-denticulatis, infero subintegerrimis;" whereas *L. chærophylla* has the leaves equally and somewhat strongly dentate all round. Moreover, *L. Sieberiana* is said to be sterile, and is therefore probably dioicous; whereas I have never seen *L. chærophylla* without perianths; nor is any mention made of the cordate base of the stipules, so conspicuous in the latter. The plant grows always on living leaves, along with the two following *Odontolejeuneæ*, and sometimes with species of other subgenera.

21. LEJEUNEA CONVEXISTIPA, *Lehm. et Lindenb. in Syn. Hep.* p. 328.—St. Vincent, Gibson mtn. (2), Mt. St. Andrews (48, 66, and 145), Morne Garu (54), Richmond Peak (354). Dominica, Morne Couronne (245 and 778), windward road to the Lake (508), and sine loc. (516).

22. L. PERUVIANA, *Lehm. et Lindenb. in Syn. Hep.* p. 339.—St. Vincent, Morne Garu (55), Richmond Peak (356). Dominica, Morne Couronne (245), and sine loc. (516).

Var. PARVISTIPULA, *Spruce.*—St. Vincent, Richmond Peak (354).

23. L. ACCEDENS, *Gottsche, in Syn. Hep.* p. 339.—St. Vincent, Mt. St. Andrews (84). Dominica, Morne Couronne (516).

24. L. SURINAMENSIS, *Mont. in Ann. Sc. Nat.* sér. II. xv. p. 110; *et in Syn. Hep.* p. 329.—St. Vincent, Richmond Peak (356).

Subgenus 12. PRIONOLEJEUNEA, *Spruce.*

The specimens referred to this subgenus are nearly all in small quantity, creeping over other hepatics or on living leaves, especially of ferns. In a final revision of my own plants I found several new species of this group, some of them in sufficient quantity to be distributed in my 'Exsiccatæ' (Malton, 1892), and three of these reappear in Mr. Elliott's collection.

25. L. DENTICULATA, *Nees, in Syn. Hep.* p. 337.—St. Vincent, Richmond Peak (208).

26. L. VULCANICA, *Spruce,* n. sp. (Tab. XXI. figs. 1–3.)

Monoica, virescens, flaccida, caule prostrato sesquipollicari inæqualiter pinnato et bipinnato. *Folia* subcontigua vel parum imbricata, late patentia, semicordato-ovata subdimidiata, acuta vel vix subacuminata, toto margine minute crenulata serrulatave, sinuato-complicata, lobulo 4plo breviore, semiovoideo subinflato subapiculato; cellulæ parvæ, subconformes, pellucidæ, trigonis nullis. *Foliola* distantia, obovato-rotunda, profunde bifida, segmentis acutis. *Flores* ♀ in ramulo brevi simplice insidentes; *bracteæ* foliis æquilongæ, oblique lanceolatæ, lobulatæ; *bracteola* anguste lanceolata, ad medium bifida, segmentis erectis acutis. *Perianthia* emersa, late obcordato-cuneata, compressa, margine supero subdenticulata. *Andrœcia* folio caulino sublongiora, paucijuga.—*Folia* ·6 × ·4–·45, *lobulus* ·125, *cellulæ* $\frac{1}{40}$–$\frac{1}{50}$; *foliola* ·13; *bracteæ* ·55, *bracteola* ·5 × ·2; *perianthia* ·7 × ·5 mm.

Hab. Ins. Dominica, super alias hepaticas repens juxta craterem volcanicum Grande Souffrière dictum, alt. 3000 ped.

(Elliott, no. 875, Dec. 1892).—*Prionol. denticulatæ* (Web.) convenit floresc. monoica, ramulo ♀ simplicissimo, differt foliis solum acutis, trigonis cellularum nullis, foliolis minutis, etc.—*Pr. æmula*, G., sat similis, folia habet grosse serrata et perianthia subciliata.

27. Lejeunea laciniato-alata, *Spruce, herb.*—Dominica, Morne Micotrin (106), on *Plagiochila Breuteliana*. (Chimborazo, R. Spruce, anno 1860.)

28. L. dissitifolia, *Spruce*, n. sp.

Dioica, rarius monoica, pusilla, pallida, caule semipollicari, prostrato, fragili, vage ramoso. *Folia* dissita, patentia vel erecto-patentia, a basi constricta obovata, apiculato-acuta, raro subobtusa, subsinuate-complicata, lobulo vix triplo breviore, ovoideo, inflato, margine toto fere muricato-serrulata; *cellulæ* minutulæ, trigonis vix ullis, ocello nullo. *Foliola* parva, foliis 4plo fere breviora, orbiculata, ultra $\frac{1}{2}$ bifida, sinu segmentisque acutis. *Flores* ramulo brevissimo simplice constantes; *bracteæ* foliis æquilongæ, angustiores, lobulo plano, fortius serrulatæ. *Perianthia* emersa, obcordato-obconica, compressa, margine supero inæqualiter spinulosa. *Andrœcia* terminalia sæpe longispica.—*Folia* ·4 × ·25, *lobulus* ·15, *cellulæ* $\frac{1}{80}$; *foliola* ·125 × ·125; *perianthia* ·6 × ·4 mm.

Hab. Ins. Sti. Vincentii, in monte Richmond, supra Trichomanis sp. frondem, *L. Guadalupensi* consociata (Elliott, no. 355 p. p., Feb. 1892).—Plantam ♂ ejusdem speciei possideo ad fluv. Bombonasa a meipso lectam anno 1857, necnon inter hepaticas Bolivianas a cl. Rusby lectas inventam.

29. L. decora, *Tayl.* ?, *in Syn. Hep.* p. 755.—St. Vincent, Richmond Peak (208).

30. L. trachyodes, *Spruce*, n. sp.

Dioica, pusilla, rufo-badia, caule pollicari vage ramoso, ramis sæpe elongatis polyphyllis. *Folia* dense imbricata, decurvo-concava, sæpe subsecunda, oblique semicordato-oblonga, acuta, rarius subapiculata, tota facie externa cellulis prominulis tuberculata, margine muricato-serrulata, valde sinuato-complicata, lobulo triplo breviore, turgide saccato, margine inflexo subhorizontali; *cellulæ* minutulæ, subopacæ, trigonis conspicuis. *Foliola* præminuta, caulem vix excedentia, orbiculata, ad $\frac{1}{3}$ bifida, segmentis acutis. *Flores* ♀ ramulo brevi simplice insidentes; *bracteæ* foliis sat longiores, patentes, oblique ovales, subacuminatæ, integerrimæ vel paucidentatæ, late lobulatæ; *bracteola* ovali-lanceolata, ad $\frac{1}{2}$ fere bifida, segmentis subacuminatis.—*Folia* ·375 × ·35 (*cum lobulo*) × ·25 (*sine lobulo*), *lobulus* ·125, *cellulæ* $\frac{1}{55}$; *foliola* ·07; *bracteæ* ·5 mm.

Hab. In monte Diablotin insulæ Dominicæ, super alias hepaticas reptans (ELLIOTT, no. 646, Oct. 1892).

31. LEJEUNEA GUADALUPENSIS, *Lindenb. in Syn. Hep.* p. 340. (Tab. XXI. figs. 4, 5.)—St. Vincent, Richmond Peak (355), in *Trichomane.* Dominica, Roseau Valley (60), "a meagre variety differing in the nearly equal leaf-cells—not wider and laxer about the middle of the leaf . . . . *L. guadalupensis* is the only *Prionolejeunea* with quite entire leaves; but the compresso-trigonous perianths with toothed margins, seated on a short proper branch, declare its affinity with *L. denticulata*, &c." [Spruce in litt. Nov. 6th, 1893.]

32. L. VALIDIUSCULA, *Spruce, Hepat. Amaz. et And. exsicc.* anno 1892.—St. Vincent, Souffrière (227). Dominica, Morne Micotrin (86).

This plant, which was first found in the Eastern Peruvian Andes, agrees with *L. microdonta*, a common Amazonian species, in the very short fertile ramulus putting forth a minute subfloral innovation, but differs in its abruptly apiculate (not very obtuse) leaves, and its deeply obcordate perianth, which is bordered in the upper half by a narrow incised wing.

33. L. VAGANS, *Spruce*, n. sp.

Dioica, virescens, prostrata, flaccida, caule sæpe bipollicari, crebre sed inæqualiter bipinnato. *Folia* subimbricata, divergentia, decurva, oblique semicordato-ovata, subabrupte acuminulata, acuta, e cellulis marginalibus conicis, acutis obtusisve, denticulata, sinuato-complicata; lobulus triplo brevior, inflatus, oblique ovato-lageniformis, margine apiceque involutus; *cellulæ* parvæ, trigonis conspicuis. *Foliola* parva, plus triplo breviora, orbiculata, ad $\frac{1}{2}$ bifida, segmentis acutis. *Flores* ♀ in ramo brevi terminales, innovatione sæpe elongata suffulti. *Bracteæ* teneræ, foliis minores, oblique obovatæ, lobulo lineari auctæ; *bracteola* oblonga, bifida. *Perianthia* alte emersa, obcordato-cuneata, compressa, apice lato retuso subalato, setuloso erosulove. *Andrœcia* folio collaterali vix longiora, 3–5-juga, in planta propria.—*Folia* ·5 × ·35, *lobulus* ·18, *cellulæ* $\frac{1}{45}$; *foliola* ·15 × ·15; *bracteæ* ·4, *bracteola* ·3 × ·15; *perianthia* ·75 × ·6 mm.

Hab. Insula Sti. Vincentii, super montem Richmond, in *Plagiochilis* repens (Elliott, no. 203, Feb. 1892).

L. validiuscula (Hepat. Spruceanæ exsicc. anno 1892) affinis, distat floribus monoicis, ♀ ramulo perbrevi, innovatione sæpius ♂ suffulto; foliis parvilobulatis, trigonis cellularum vix ullis; foliolis duplo majoribus, profundius fissis; perianthiis apice profunde emarginatis.

34. Lejeunea effusa, *Spruce*, n. sp.

Dioica, albicans, caule 2-pollicari, flaccido, fragili, vage ramoso, in matrice repens. *Folia* subimbricata, subdivergentia, decurvo-concava, a basi constricta semicordato-ovata, abrupte apiculata cuspidatave—caulina interdum solum acuta, toto ambitu celluloso-serrulata-crenulatave, valide sinuato-complicata; *lobulus* triplo brevior, turgidus, saccatus, margine apiceque incurvis; *cellulæ* parvæ, subæquales, trigonis minutis vel vix ullis, paucæ (2-4) sub lobuli margine ceteris majores, vacuæ, ocellum sistentes. *Foliola* parva, lobulis subbreviora, subrotunda, ad $\frac{1}{2}$ obtuse bifida, segmentis obtusis rarius acutis. *Andrœcia* plerumque brevispica. *Flores* ♀ ramulo brevissimo simplice constantes. *Bracteæ* foliis sat minores, serrulatæ, lobo ovali-lanceolato acuto, lobulo vix duplo breviore obtuso; *bracteola* obovato-lanceolata, ad $\frac{1}{3}$ fissa, sinu segmentisque acutis. *Perianthia* alte emersa, anguste obcordato-cuneata, compressa, subtus convexa, margine supra medium sparsim denticulata.—*Folia* ·5 × ·32, *lobulus* ·16, *cellulæ* $\frac{1}{50}$; *foliola* ·15 × ·15 mm.

Hab. In monte Chimborazo super *Plagiochilas* repens (R. Spruce, 1860). Situ simili montis Sti. Andreæ ins. Sti. Vincentii legit cl. Elliott, sub no. 83, anno 1892.—A *Pr. denticulata* distat floresc. dioica, foliis haud acuminatis, cellularum trigonis subnullis, etc.

35. L. leptocardia, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 159.—St. Vincent, Mt. St. Andrews (84).

Subgenus 13. Drepanolejeunea, *Spruce*.

36. L. inchoata, *Meissn. in Syn. Hep.* p. 343.—St. Vincent, Mariaqua (22), Richmond Peak (356). Souffrière, forma foliis secundis (227).—Var. perissodonta, *S.*; foliis spina longa margine antico auctis. Dominica, sine loc. (516).

37. L. anoplantha, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 189.—Dominica, Basin Will (505).

Subgenus 14. CHEILOLEJEUNEA, *Spruce*.

38. LEJEUNEA LINEATA, *Lehm. et Lindenb. in Syn. Hep.* p. 371.—St. Vincent, Souffrière (48), Mt. St. Andrews (69), Richmond Peak (163). Dominica, Morne Micotrin (90), Morne Diablotin (673). Not infrequent in both the islands, but rarely possessing good perianths. It grows among *Plagiochila, Sendtnera*, &c., and is one of the largest and most conspicuous plants in the genus. It is absent from equatorial America, but is found in Bourbon.

Subgenus 15. HARPALEJEUNEA, *Spruce*.

39. L. TENUICUSPIS, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 170.—St. Vincent, Richmond Peak (211), Richmond Valley (221), mixed with other hepatics. (Anne eadem ac *L. oxyphylla*, Nees et Mont., Syn. Hep. p. 357, cui tamen stipulæ ademptæ—forsan prætervisæ ?).—[Mr. Spruce wrote *L. longicuspis*, which is unknown; but that he meant *tenuicuspis* I have ascertained by the examination of original specimens which were kindly sent to me by Mr. Slater.—A. G.]

40. L. TRIDENS, *Spruce et Besch., in Bull. Soc. Bot. France* (1890), p. clxxxi, pl. 13. (N.B.—The three teeth or spines are often much longer than they are represented in this plate.) —Dominica, Bonhomme mtn. (80) and elsewhere, but always sterile.

41. L. ASPERRIMA, *Spruce*; *Prionolejeunea asperrima*, Spruce, in Trans. Bot. Soc. Edinb. xv. p. 160.—St. Vincent, Morne Garu (53).

Subgenus 16. STREPSILEJEUNEA, *Spruce*.

42. L. INFLEXA, *Hampe, in Syn. Hep.* p. 350.—St. Vincent, Mt. St. Andrews (84).

43. L. INVOLUTA, *Gottsche, in Syn. Hep.* p. 350.—St. Vincent, Mt. St. Andrews (48, 67). Dominica, Morne Couronne (233).

44. L. KUNTHIANA, *Lindenb. in Syn. Hep.* p. 353.—Dominica, Morne Micotrin (84), in *Bazzaniæ* sp. repens.

Subgenus 17. CERATOLEJEUNEA, *Spruce*.

45. L. PLUMULA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 201. —St. Vincent, Richmond Peak (217).

46. LEJEUNEA SPINOSA, *Gottsche, in Syn. Hep.* p. 402.—St. Vincent, Mt. St. Andrews (63 & 85—in *Anthurii* folio). Dominica, Morne Diablotin (683), Morne Trois Pitons (769).

47. L. VARIABILIS, *Lindenb. in Syn. Hep.* p. 399.—St. Vincent, Mt. St. Andrews (85—in *Anthurii* folio, cum *L. spinosa*), Richmond Peak (208). Dominica, sine loc. (516).

48. L. BREVINERVIS, *Spruce*, n. sp. (Tab. XXI. figs. 6–9.)

Dioica, elata, nigricans, caule 5 cm. longo pinnatim ramoso, ramis sæpe ramulis brevibus pinnulatis. *Folia* subimbricata divergentia late semiovata, apice valide decurvo, abrupte subacuta obtusave, raro rotundata, basin versus sinuato-complicata, lobulo parvo (folio 5plo breviore) horizontali ovoideo inflato, apice incurvo acuto; *cellulæ* parvulæ leptodermes, 6 axiales, prope folii basin, cæteris cellulis duplo majores, primum opacæ demum vacuæ, in lineam (nervum simulantem) ordinatæ. *Foliola* foliis triplo fere—raro solum duplo—breviora, orbiculata, ad $\frac{1}{2}$ biloba, lobis subacutis. *Flores* ♀ in ramo, innovatione simplice continuato, insidentes; *bracteæ* foliis longiores, oblique ovato-oblongæ, apiculatæ, sæpe apice obsolete denticulatæ; *bracteola* ovata, ultra medium bifida, segmentis erectis acuminatis. *Perianthia* obovata, obtuse tetragona, angulis in cornua lineari-subulata subobtusa, cætero perianthio subæquilonga, erecto-patula, abeuntia.—*Folia* 1·0 × ·75, *lobulus* ·2, *cellulæ* $\frac{1}{40}$; *foliola* ·35–·5; *bracteæ* 1·3, *bracteola* ·8 × ·6; *perianthia* 1·3 × ·5 mm.

Hab. Ins. Guadalupa, ad arbores, *Lejeuneæ filiformi* consociata (L'HERMINIER). Ins. Dominica in monte Diablotin (ELLIOTT, no. 658, 681, a. 1892), in monte Micotrin (ELLIOTT, no. 67, a. 1892).

There are besides two sterile dioicous species, viz. St. Vincent, Morne Garu (54), Grand Bonhomme Valley (86)—*L. cubensi* affin.; and Dominica, Shawford Estate (895)—*L. cornutæ* affin.

Subgenus 18. TAXILEJEUNEA, *Spruce*.

49. L. SULPHUREA, *Spruce, in Trans. Bot. Soc. Edinb.* XV. p. 217; *Omphalanthus sulphureus*, Lehm. & Lindenb. in Syn. Hep. p. 307.—St. Vincent, Mt. St. Andrews (83), Souffrière (146), Richmond Peak (207). Dominica, Roseau Valley (87), Morne Diablotin (673).

This plant is easily recognized by its large size, pale yellowish or white colour, and especially by the large stipules and by the

smooth (eplicate) perianth, dilated at the inflexed and corrugated apex. It occurs in the Antilles, and at the roots of the Eastern Andes, extending as far south as Bolivia. It creeps over ferns and the living leaves of trees.

50. Lejeunea graminicolor, *Spruce*, n. sp. (Tab. XXII. figs. 1–3.)

Monoica, læte virens, prostrata, caule pollicari paucirameo. *Folia* subimbricata, plana semicordato-ovato-oblonga, acuminulata, acuta, apicem versus sæpe angulata vel unidentata, subrecte complicata; *lobulus* vix triplo brevior, anguste ovatus, subinflatus; *cellulæ* mediocres, pellucidæ, subæquales, trigonis nullis. *Foliola* triplo breviora, distantia, ovato-orbiculata, ad $\frac{1}{2}$ acute bifida, segmentis peracutis. *Flores* ♀ in ramo innovando quasi-seriati; *bracteæ* foliis sat minores angusti oresque, erectæ, integerrimæ. *Perianthia* emersa, obconico-cylindrica, apice subtruncato 5-carinata, lævia. *Andrœcia* brevispica.—*Folia* ·8 × ·7, *lobulus* ·3, *cellulæ* $\frac{1}{28}$–$\frac{1}{25}$; *foliola* ·25 × ·25; *perianthia* 1·0 × 0·4 mm.

Hab. Ins. Sti. Vincentii, in monte Bonhomme, super *Plagiochilas* repens (Elliott, no. 80, 92, Dec. 1891).

Subgenus 19. Macrolejeunea, *Spruce*.

51. L. subsimplex, *Nees et Mont. in Ann. Sc. Nat.* sér. II. xix. p. 264; *et in Syn. Hep.* p. 391.—Dominica, Morne Micotrin (90), Morne Couronne (217, 227, 233).

The perianth is turgid, 4–5-angled. The plant is common on ferns and the living leaves of trees.

Subgenus 20. Hygrolejeunea, *Spruce*.

52. L. cerina, *Lehm. et Lindenb. in Syn. Hep.* p. 391.—St. Vincent, Mt. St. Andrews (84). Dominica, Morne Couronne (233).

This species has a wide distribution in tropical America, being found in the Antilles and Bolivia, yet like *L. xanthocarpa* it has not been noted on the Equator. It is replaced in the lower Peruvian Andes by an allied but very distinct species—*L. devoluta* (Trans. Bot. Soc. Edinb. xv. p. 236, tab. 9). The *Hygrolejeuneæ* of South America are chiefly montane in habit. Of a dozen species gathered by me only two descend into the plain. All Mr. Elliott's species belong to the highest regions explored by him.

53. Lejeunea frangibilis, *Spruce*, n. sp.

Dioica, virescens, flaccida, fragilis, caule pollicari prostrato, paucirameo, ramis sæpe parvifoliis. *Folia* subimbricata, supra lobulum divergentia, subplana, a basi constricta semicordato-ovato-oblonga vel subrotunda, abrupte acuminulata, rarius solum acuta obtusave, valde sinuato-complicata, celluloso-subcrenulata; *lobulus* triplo brevior, turgidus, e marginis inflexione late semiovatus; *cellulæ* parvulæ, subpellucidæ, trigonis nullis. *Foliola* foliis æquimagna, transversa tamen, subimbricata, late cordato-orbiculata, ad $\frac{1}{3}$ bifida, segmentis plus minus obtusis.—*Folia* ·6 × ·4, ·5 × ·4, *lobulus* ·2–·125, *cellulæ* $\frac{1}{45}$; *foliola* ·5 × ·6, ·4 × ·5 mm.

Hab. Dominica, in montis cacumine Grande Souffrière dicti, alt. 3000 ped. (Elliott, no. 885, 886, Dec. 1892).—*Hygrol. fulva*, Hep. Amaz. p. 237, distat colore, foliis majoribus, lobulo autem pro ratione minore, omnibus obtusatis; foliolis apice solum ad $\frac{1}{6}$ acute fissis.—Ex habitatione et foliolis magnis obtusilobis eandem speciem censeres ac *Lejeunea Dominicensis*, Mont. Ann. des Sc. Nat. (1843); Syn. Hep. p. 351; cui tamen adscripta sunt caulis rigidus et folia arctissime imbricata. Forsan ejusdem varietas erit.

54. L. corynantha, *Spruce*, n. sp. (Tab. XXII. figs. 4–9.)

Monoica, majuscula, sordide rufo-viridis, tenerrima, caule sesquipollicari, paucirameo, ramisque arcuato-flexuosis. *Folia* subimbricata, a basi ad plicam rotundata suberecta, ad lobuli apicem sinuato-subdivergentia, valde oblique ovato-oblonga, rotundata, cochleato-concava; *lobulus* duplo brevior, rotundo-quadratus, basi turgidus margine appressus, apice truncato-obtusus; *cellulæ* subpellucidæ, leptodermes, superiores parvulæ subæquilateræ, mediæ inferiores submajores et oblongæ, marginales anticæ basin versus lineares. *Foliola* triplo fere breviora, suborbiculata, ad $\frac{1}{3}$ bifida, segmentis acutis. *Flores* ♀ innovati; *bracteæ* foliis submajores, obovatæ, lobulo late lineari, cum bracteola oblonga ad $\frac{1}{3}$ acute bifida utrinque alte connatæ. *Perianthia* sat alte emersa, fulva, clavato-cylindrica, *teretia*, solum in apice lato inflexo (cito disrupto) obscure 5-angula. *Andrœcia* amentiformia, tenuia, bracteis 5–8-jugis.—*Folia* ·65 × ·4, *lobulus* ·3, *cellulæ superiores* $\frac{1}{40}$, *inferiores anticæ* $\frac{1}{20}$; *foliola* ·25 × ·25; *bracteæ* ·75; *perianthia* 1·0 × ·4–·5 mm.

Hab. Dominica, in monte Trois Pitons dicto, ad ligna, socio *Drepanol. inchoata* (Elliott, no. 773, Nov. 1892).

55. LEJEUNEA LEIANTHA, *Spruce*, n. sp.

Monoica, pallide viridis, prostrata, caule sesquipollicari flaccido, inæqualiter pinnatim ramoso. *Folia* imbricata, subdivergentia, cochleato-subconcava, a basi constricta oblique transverse oblonga, rotundata, raro solum obtusa, sinuato-complicata, lobulo plus triplo breviore, turgido; *cellulæ* parvulæ, subconformes, trigonis nullis. *Foliola* 4plo minora, obovato-rotunda, vix ad medium usque bifida, segmentis obtusis subacutisve. *Flores* ♀ in ramo brevi innovato terminales; *bracteæ* foliis æquales, obovato-oblongæ, sæpe acutæ, lobulo parvo plano haud complicatæ; *bracteola* lineari-oblonga, breviter bifida, segmentis obtusis. *Perianthia* alte emersa, ovali-cylindrica, subcompressa, *ecarinata*, apice retuso umbonata, demum valde elongata infundibulata, apice semper fere rupta et hiantia. *Andrœcia* parva, 4–5-juga, facile caduca.—*Folia* ·5 × ·5, *lobulus* ·15, *cellulæ* $\frac{1}{40}$; *foliola* ·125; *bracteæ* ·5, *bracteola* ·35 × ·13; *perianthia* ·8 × ·3 mm.

Hab. In monte Micotrin, ins. Dominicæ, ad rupes super *Symphyogynam trivittatam* repens (ELLIOTT, no. 86 p. p., Junio 1892).—A *H. corynantha* certe differt foliis brevioribus sed latioribus, lobulo duplo minore magis saccato; foliolis duplo minoribus; cellulis magis æqualibus; bracteis perianthiisque minoribus.

56. L. PATELLIFERA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 234.—St. Vincent, Richmond Valley (212),—a few stems creeping on a *Radula*.

57. L. MATTEOLA?, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 240.—Dominica, Morne Diablotin (646),—sterile.

Subgenus 21. EUOSMOLEJEUNEA, *Spruce*.

58. L. TRIFARIA, *Nees, in Syn. Hep.* p. 361.—Dominica, Roseau Valley (72, 80), Morne Couronne (216, 230), Shawford Estate (896),—often forming continuous patches on bark, and reaching a moderate elevation in the mountains.

The name which I gave to this subgenus was suggested by the sweet odour which is a marked feature in all the Amazonian species, some of which, after a lapse of more than 40 years, still give out their fine scent of sweetbriar when moistened. Yet, curiously enough, although the three West-Indian species here enumerated are all found on the Amazon, not one of them has any perceptible odour. Possibly what they originally possessed has

been neutralized by the proximity of numerous specimens of other hepatics, thickly coated with a sulphurous deposit, along with which they were packed. They are all species of the plain, save one.

59. LEJEUNEA CLAUSA, *Mont. in Ann. Sc. Nat.* sér. II. xiv. p. 337; *et in Syn. Hep.* p. 365.—St. Vincent, Kingstown (1), Fancy farm (343). Dominica, Roseau Valley (60, 243 ?).

60. L. DURIUSCULA, *Nees, in Syn. Hep.* p. 364.—St. Vincent, Morne Garu (55); Richmond Peak (213, 217).

Subgenus 22. EULEJEUNEA, *Spruce*.

In this group, of which our native *L. serpyllifolia* is the type, out of seven species found by Mr. Elliott three are new. *L. flava*, so common in tropical America and found northward as far as Madeira and S.W. Ireland, was gathered but once.

61. L. ELLIOTTII, *Spruce*, n. sp. (Tab. XXIII. figs. 1–5.)

Monoica, pusilla, depresso-cæspitosa, virescens, caule semipollicari vage ramoso intricato. *Folia* imbricata, patenti-divergentia, oblique vel subsemi-ovata, obtusata, rotundatave, raro abrupte subacuta, margine antico totove celluloso-denticulata, valde sinuato-complicata; *lobulus* triplo brevior, turgide ovatus apice acuto plerumque inflexus; *cellulæ* parvæ, leptodermes, subpellucidæ, marginales subconicæ. *Foliola* minuta, caule velata vel eodem vix latiora, subrotunda, ad $\frac{1}{2}$ bifida, segmentis subacutis basi 4 cellulas latis. *Flores* ♀ in ramo brevi innovato terminales; *bracteæ* foliis duplo fere breviores, ovato-rotundæ, lobulatæ, cum bracteola biloba alte connatæ. *Perianthia* alte emersa, obovata, compressula, brevirostria, 5-carinata, carinis papillis subulatis unicellularibus crebre obsessis. *Andrœcia* rara, brevispica.—*Folia* ·4 × ·25, *lobulus* ·13, *cellulæ* $\frac{1}{50}$; *bracteæ* ·25; *perianthia* ·5 × ·25 mm.

Hab. Insula Sti. Vincentii, monte Mariaqua, alt. 2600 ped., in cortice (ELLIOTT, no. 32, Dec. 1891); etiam in monte Richmond (ELLIOTT, no. 186 p. p., Feb. 1892).

62. L. PILILOBA, *Spruce*, n. sp. (Tab. XXIII. figs. 6–8.)

Dioica, viridis, tenerrima, prostrata, cæspitosa, pauciramea, caule pollicari. *Folia* majuscula, subimbricata, patentia, plana

oblique ovata, subsemicordata, plus minus obtusa, basi peranguste complicata, e plica lobulum diagonalem, dimidio folio fere æquilongum, filiformem, cellulis 12 in longitudine, interdum uniseriatis vel solum in ipsa basi 2–3-seriatis, rarius sublatiorem et ex p. subulatum proferentia; *cellulæ* parvulæ æquilatero-hexagonæ vel subquadratæ, leptodermes, subchlorophyllosæ. *Foliola* duplo breviora, subcontigua, ovali-lanceolata, profunde bifida, segmentis erectis angustis acuminatis. *Flores* nullos invenire potui. —*Folia* ·8 × ·6, *lobulus* ·35, *cellulæ* $\frac{1}{40}$; *foliola* ·4 × ·15–·2 mm.

Hab. Dominica, ad saxa murosque in valle Roseau (ELLIOTT, no. 77 et 566, anno 1892).

Eulej. setilobæ nostræ (Hep. Amaz. 281) proxima; quæ tamen minor est, lobulo foliorum solum 4 cell. longo; foliolis minutis ad $\frac{1}{2}$ tantum bifidis.

63. LEJEUNEA FLAVA, *Gottsche, in Syn. Hep.* 373; *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 268.—Dominica, Shawford Estate (897).

64. L. URBANI, *Steph. in Hedwigia*, 1888, p. 301.—St. Vincent, Richmond Valley (212). Previously found in San Domingo by Eggers.

65. L. DISJECTA, n. sp. (Tab. XXIV. figs. 1–4.)

Monoica, virescens, caule $\frac{1}{2}$-1-pollicari, inæqualiter pinnatim ramoso. *Folia* subimbricata, late patentia, subplana, facile caduca, oblique oblonga ovatove-oblonga, rotundata, basi antica dilatata non autem semicordata, postica subsinuato-complicata; *lobulus* 4plo brevior, inflatus, exciso-acutus; *cellulæ* subparvulæ, ubique conformes fere, chlorophyllo parco, trigonis nullis. *Foliola* in uno et eodem caule valde inæquimagna, foliis 2–4plo breviora, ovato-rotunda, ad $\frac{1}{2}$ bifida, segmentis subacutis. *Flores* ♀ in caule ramisque terminales, innovati; *bracteæ* foliis majores, subfalcato-oblongæ, late patentes, lobulo duplo breviore oblique cuneato vel subrhomboideo; *bracteola* obovata, ad $\frac{1}{2}$ bifida, segmentis ovatis apiculato-acutis. *Perianthia* emersa, obconico-obovata, compressula, antice carinulata, postice alte bicarinata, margine carinisque repanda. *Andrœcia* spicata, paucijuga.—*Folia* ·6 × ·4, ·45 × ·35, *lobulus* ·125, *cellulæ* $\frac{1}{35}$; *foliola* ·3 × ·3, ·15 × ·1; *bracteæ* ·8, *bracteola* ·6 × ·45; *perianthia* ·9 × ·6 mm.

Hab. Super alias hepaticas laxe reptans ad arbores in monte

Mariaqua, alt. 2600 ped., insulæ Sti. Vincentii (ELLIOTT, no. 32 p. p., Dec. 1891), cum *Lejeunea Elliottii*.

66. LEJEUNEA GLAUCOPHYLLA, *Gottsche* [? an error for *L. glaucescens*, Gottsche, in Syn. Hep. p. 378.—A. G.].—St. Vincent, near Fort Charles (199).

67. L. LUCENS, *Tayl. in Syn. Hep.* p. 764; *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 288.—Dominica, River Douce Valley (708).

Subgenus 23. MICROLEJEUNEA, *Spruce*.

68. L. ERECTIFOLIA, *Spruce*. *Harpalejeunea erectifolia*, Spruce, in Trans. Bot. Soc. Edinb. xv. p. 173.—St. Vincent, Richmond Valley (212), creeping on a *Radula*.

69. L. MEGALANTHA, *Spruce*. *Harpalejeunea megalantha*, Spruce, in Trans. Bot. Soc. Edinb. xv. p. 172.—St. Vincent, Richmond Valley (212), with the last-mentioned species.

70. L. ATHEATOSTIPA, *Spruce, MS.*—St. Vincent, Richmond Valley (212), with the two preceding species. (Picked out of Wright's Cuban hepatics some years ago.)

71. L. HOLOSTIPA, *Spruce*. *Harpalejeunea holostipa*, Spruce, in Trans. Bot. Soc. Edinb. xv. p. 171.—Creeping over *Odontolejeunea peruviana* and other species, sparingly and always sterile.—St. Vincent, Morne Garu (55), &c.

Subgenus 24. COLOLEJEUNEA, *Spruce*.

72. L. HETEROMORPHA, *Spruce*, n. sp. (Tab. XXIV. figs. 5–9.)

Monoica, minuta, tenera, virescens, caule 3 mm. longo vage ramoso intricato. *Folia* dissita, plana vel subcarinata haud complicata, alia ovata obtusa, alia subquadrata retusa vel (superiora præcipue) subbifida, celluloso-subcrenulata; *cellulæ* minutulæ, convexulæ, subæquilateræ, trigonis nullis. *Foliola* nulla. *Flores* ♀ innovati; *bracteæ* foliis sensim majores, laxiusculæ, heteromorphæ, sæpe cuneato-quadratæ, rotundatæ, retusæ bifidulæve. *Perianthia* subemersa, obovata, brevirostria, 5-carinata, subpapulosa. *Andrœcia* spicata; *bracteæ* sub 6-jugæ, majusculæ, imbricatulæ, cymbiformes.—*Folia inferiora* ·1, *superiora bracteæque* ·2–·3 mm. *longæ*; *cellulæ* $\frac{1}{60}$; *perianthia* ·3 × ·25 mm.

Hab. Juxta viam quæ ducit ad Fort Charles, Kingstown, Sti. Vincentii, corticola (ELLIOTT, no. 199, Dec. 1891).

Subgenus 25. Diplasiolejeunea, *Spruce*.

73. Lejeunea pellucida, *Meissn. in Syn. Hep.* p. 393.—St. Vincent, Mariaqua (22), Gibson mtn. (9), Richmond Peak (356). Dominica, Morne Couronne (233).

Tribus II. *JUNGERMANNIEÆ.*

Subtribus i. *RADULEÆ.*

Genus 3. Radula, *Dum.*

The species of this genus are fairly abundant. Ten are here enumerated, whereas six are recorded from the French Antilles. In one case (St. Vincent, Richmond Valley (212), on trees) three species grew intermixed; yet they are very distinct from each other:—*R. Fendleri*, Gottsch., *R. angulata*, Steph., and *R. portoricensis*, Steph. The last is a very elegant species, notable for its reddish colour. In this last feature it agrees with *R. subsimplex*, Steph.—rather unhappily named, for the stems are usually pinnate, and one stem I have from Guadeloupe is bipinnate. The leaves are nearly always widely incurved at the outer margin; but in *R. portoricensis* gently incurved all round and concave. *R. pallens* occurs repeatedly, but does not vary widely.

74. R. pallens, *Nees, in Syn. Hep.* p. 256.—Dominica, Morne Micotrin (89, 90, 98), Morne Trois Pitons (724).

? Var.—St. Vincent, Morne Garu (53, 62). Dominica, Morne Trois Pitons (727, 778).

75. R. tenella, *Gottsch. Mexikan. Leverm.* 1863, p. 149.—Dominica, Morne Couronne (245), on living leaves, often fertile. Occurs also mixed with foliicolous *Lejeuneæ* under other numbers, *e. g.* 516.

76. R. angulata, *Steph. in Hedwigia*, 1884, p. 114.—St. Vincent, Richmond Peak (211), Richmond Valley (112). Also perhaps Dominica, Morne Couronne (227).

77. R. Fendleri, *Gottsch. et Stephani, in Hedwigia*, 1884, p. 146. —St. Vincent, Richmond Valley (212, 221). Dominica, Morne Couronne (216, 227, 233).

78. R. Korthalsii, *Steph. in Hedwigia*, 1884, p. 133.—St. Vincent, Gibson mtn. (2), Richmond Peak (213).

79. **Radula subsimplex**, *Steph. in Hedwigia*, 1884, p. 130. (Tab. XXV. figs. 1–3.)

Dioica, elata, tota rufescens; caule 5–7 cm. longo, pinnato, pinnis inæquilongis, plerisque brevibus, simplicibus furcatisve, rarius pinnulatis, omnibus subæquifoliatis. *Folia* subimbricata, late patentia, semicordato-orbiculata, plus minus concava, margine externo semper fere late incurvo; *lobulus* 4plo brevior, trapeziformis, ad carinam angulo 50° ascendentem, rectam vel subconvexam inflatus, margine sinûs cum folii margine (explanato) fere recte continuus, basi in caule alte incurrens, angulo breviter libero anguste incumbens; *cellulæ* minutæ, opacæ, trigonis nullis. *Flores* ♀ terminales, sæpe dichotomiales; *bracteæ* foliis multo minores, appressæ. *Perianthia* alte emersa, obconico-clavata, e basi longe attenuata subinfundibulata, ore compressa truncata et crenulata. *Andrœcia* in ramis terminalia mediave; *bracteæ* paucijugæ, diandræ.—*Folia* 1·3 × 1·35, *lobulus* ·4–·5 (*ad carinam*), *cellulæ* $\frac{1}{60}$–$\frac{1}{70}$; *perianthia* 2·5–3·0 × 1·0–1·2 mm.

Hab. Dominica, ad arbores in monte Micotrin (Elliott, no. 99), etiam in monte Diablotin (Elliott, nos. 649 et 671, Oct. 1892).—Species insignis colore rufulo, foliisque margine externo late incurvis; in *R. inflexa* tamen folia magis elongata apicem habent late incurvum vel etiam involutum.

80. **R. portoricensis**, *Steph. in Hedwigia*, 1888, p. 298.—St. Vincent, Richmond Valley (212).

81. **R. saccatiloba**, *Steph. in Hedwigia*, 1884, p. 129.—Dominica, Morne Diablotin (no. ?). A solitary stem.

82. **R. inflexa**, *Gottsch.*, *Steph. in Hedwigia*, 1884, p. 148.—Dominica, Morne Diablotin (671, 673, 685).

83. **R. tectiloba** ?, *Steph. in Hedwigia*, 1888, p. 298.—Dominica, Morne Couronne (216).

Subtribus ii. *PTILIDIEÆ.*

Genus 4. Isotachis, *Mitt.*

84. **I. serrulata**, *Husnot, in Rev. Bry.* 1875, p. 2. *Jungermannia serrulata*, Sw. Prod. Fl. Ind. Occ. 143.—Dominica, Grande Souffrière (810, 811, 866, 877), windward road to the Lake (509), Roseau Valley (92, 93), Morne Micotrin (71).

Var. **purpurea**, *Jung. serrulata*, var. *purpurea*, Hook. Bot. Misc. i. p. 13, t. 10.—Dominica, Grande Souffrière (812, 813, 814).

Other varieties are Dominica, Grande Souffrière (815, 838, 863, 865, 868).

This species, which is figured in Hooker's 'Musci Exotici,' tab. 88, is represented by the largest number of specimens of any in Mr. Elliott's collection. They were mostly gathered on the Grande Souffrière mountain in Dominica, and at the margin of "the Boiling Lake," at an elevation of about 4000 feet, and are often thickly coated with sulphur and other mineral deposits. In colour they vary from nearly white to the sanguineous hue of var. *purpurea*, Hook. Bot. Misc. vol. i. p. 13, and in the degree of cutting of the leaf-margins from deeply dentate all round to nearly or even quite entire; but I fail to find any characters sufficiently constant to separate them into more than one species; and the four "species" into which the *Isotachis* of the Souffrière of Guadeloupe has been divided are to me unintelligible. It might, however, be interesting to whoever could spare the time and pains to trace out the varieties of this polymorphous species.

In every *Isotachis* the outermost coat of the fleshy perianth is really the essential layer. It exists *ab initio*, and extends to the very apex at maturity. The inner layers, variable in number, vary also in height; but all fail below the summit, which occurs rarely with a narrow free laciniate apex. I went over this question when I was describing *Pleuroclada*, a near ally of *Isotachis*, for my memoir "On *Cephalozia*" (1882). The perianth, usually 5–8 cells thick below the middle (though I found one from the Swiss Alps only 3 cells thick), has exactly the same structure as in *Isotachis*, as I proved by cutting vertical sections of several perianths. Our commoner hepatics are apt to have the perianth abnormally thickened when they grow in a cool region, above their normal range. When this happens to *Cephalozia bicuspidata*, it becomes the var. *alpicola* of Massal. et Carestia, "Epatiche delle Alpe Pennine" in 'Nuovo Giorn. Bot.' xii. tav. 10.

A very near ally of *Isotachis* is the minute *Jungermannia laxifolia*, Hook., of our northern rills, on which I founded the new genus *Hygrobiella*—so near, indeed, that I thought of making it a subgenus of *Isotachis*: the underleaves nearly equalling in size the bifid side-leaves, the lax elongate cells, such as exist in every *Isotachis*, the fusiform perianth, narrowed at the apex and nearly closed, triquetrous but not plicate, nor yet constricted by the folding of a normally truncate perianth as in *Cephalozia*, &c. The perianth, however, is only slightly thickened; and the oblong (not cylindrical) capsule has straight valves, not twisted as in every true *Isotachis*, and the male flowers are 1- (not 2- or 3-) androus.

85. ISOTACHIS ERYTHRORHIZA, *Besch. in Journ. de Bot.* 1893, p. 184.—Dominica, Roseau Valley (74, 109), Grande Souffrière (874).

Genus 5. SENDTNERA, *Endl.*

86. S. JUNIPERINA, *Nees, in Syn. Hep.* p. 239.—St. Vincent, Mt. St. Andrew's (69), Richmond Peak (163). Dominica, Morne Trois Pitons (482, 735), Morne Diablotin (679).—This species appears to be not uncommon on the mountains of both islands. The following species, which I believe to be new, was found only once.

87. SENDTNERA ELLIOTTII, *Spruce*, n. sp. (Tab. XXV. figs. 4–10.) *Dioica*, cæspitosa, flavo-viridis, basi rhizomatosa intricato-ramosa, caules assurgentes, 3 cm. longos, simplices vel pauci-rameos proferens. *Folia* parvula, densa, patenti-secunda, profunde (ad $\frac{3}{4}$ usque) bifida, basi vaginante quadrata, late flavo-vittata, margine rude pauciserrata laciniatave, dentibus 1–4 sursum versis (nec runcinatis); crura subulata, sensim acuminata acuta, insigniter carinata et ad carinas cellulis 4–5-seriatis flavis vittata; *cellulæ* omnes pachydermes, trigonis magnis, alares mediocres pallidæ, oblongæ, ad vittam duplo majores. *Andrœcia* medio caule posita; *bracteæ* f. caulinis consecutivæ, turgidiores, diandræ. Planta ♀ abest.—*Folia* 2·0 mm. *longa*, *basis* ·5 × ·8, *crura* 1·5, *cellulæ alares* $\frac{1}{32}$ mm.

Hab. Insula Dominica, in monte Trois Pitons dicto, ad arbores (ELLIOTT, no. 734, Nov. 1892).—*S. runcinata*, Tayl., et *S. acanthelia*, nob. (*Herberta acanthelia*, Spruce, in Trans. Bot. Soc. Edinb. xv. p. 344), longe robustiores sunt, foliis basi spinis ciliisve deorsum hamatis armatæ, hæc etiam foliorum cruribus longissime acuminatis obscurius vittatis, illa foliis solum ad dimidium bifidis diversa est.

Genus 6. TRICHOCOLEA, *Dum.*

I have reinstated the generic name *Trichocolea* for the tropical species with the involucre quite free from the calyptra, for which I had adopted Lindberg's name *Leiomitra* in 'Hep. Amaz.'

p. 347. There is really no other difference, and the foliage and all essential characters of the fruit are so exactly the same in both groups that it seems unnatural to separate them. Moreover, although the calyptra is not veiled by the adherent involucre, it is in most species bristled over with the persistent sterile styles; so that the name *Leiomitra* can hardly be called appropriate.

Subgenus LEIOMITRA, *Lindb.*

88. TRICHOCOLEA TOMENTOSA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 348.—St. Vincent, Richmond Peak (218). Dominica, Morne Micotrin (88).

Var. PLATYCLADA, *Spruce* (vel sp. nova).—Dominica, Roseau Valley (91), Morne Couronne (245).

89. T. FLACCIDA, *Spruce*. *Leiomitra flaccida*, Spruce, in Trans. Bot. Soc. Edinb. xv. p. 349.—Dominica, Morne Couronne (218).

90. T. (LEIOMITRA) GRACILLIMA, *Spruce*, n. sp.

Dioica, alba, tenuissima, caule 5 cm. longo, simpliciter pinnato, prostrato. *Folia* laxiuscula, subsquarrosa, profunde 4-fida, limbo basali pro m. unicam cellulam lato; crura 2 cellulas lata, 1 v. 2 cell. longa, apice trifurca, dein semel bisve bifurca, cellulis furcarum uniseriatis, 5plo longioribus quam latis. *Foliola* foliis conformia, sæpe solum tricrura.—*Folia* 0·8, *cellulæ* 0·15 × ·03 mm.

Hab. In monte Diablotin insulæ Domicniæ, ad arbores (ELLIOTT, no. 684, Oct. 1892).

Subtribus iii. *TRIGONANTHEÆ* s. *HYPOGYNEÆ.*

§ 1. *Cephalozieæ.*

Genus 7. CEPHALOZIA, *Dum.*

In *Cephalozia* proper there is but one species, found in small quantity creeping over an *Aneura* at the Grande Souffrière of Dominica, but in a good state of fruit, which has enabled me to describe it. It had already been found in Cuba by Wright, and named by Gottsche *Jungermannia Wrightii*. It is interesting from being a close ally of the most beautiful of our British *Cephaloziæ* (*C. curvifolia*), from which it differs mainly in the presence of marginal teeth or spines, but has the same saccate asymmetrical base.

91. Cephalozia Wrightii, *Gottsche, MS.*, var. bicornis, *Spruce.* (Tab. XXVI. figs. 1–4.)

Monoica et *dioica.* Pusilla, tenera, virescens, caule 2 cm. longo arcte repente, tenui, flexuoso, ramisque (paucis, longis, sæpe arcuantibus) æqualiter densifoliis. *Folia* imbricata, assurgenti-secunda, oblique oblonga, ultra $\frac{1}{2}$ bifida, segmentis angustis sensim cuspidatis, cuspide cellulis 4–8 uniseriatis constante, circinato-forficatis et cum contrariis intextis; margine externo medio dentibus sub 3, dissitis armata, sinu prælato semicirculari plerumque dentes 2, longiores monstrante, dentibus omnibus conicis unicellularibus; basi postica in sacculum oviformem ultra caulem exstantem protracta; *cellulæ* subparvulæ, oblongo-hexagonæ, parum chlorophyllosæ. *Foliola* nulla. *Flores* ♀ ramulo brevi postico constantes; *bracteæ* tristichæ, subtrijugæ, foliis triplo fere majores, ovatæ, carinatæ, ad $\frac{1}{3}$–$\frac{1}{4}$ bilobæ, lobis sensim acuminatis, acutis, margine infero denticulatæ, supero crebre spinulosæ. *Perianthia* magna, bracteas duplo superantia, lineari-prismatica, triquetra, medio sæpe cingulo purpureo ornata, ore recte truncato crebre setosa ciliolatave. *Andrœcia* plurijuga, in caule ramisque basalia terminaliave; *bracteæ* foliis subminores, breviter bifidæ, segmentis strictis, acuminatis (cuspide nulla), basi esaccatæ, antice tamen lobulo inflato antheridium solitarium velante auctæ.—*Folia* ·5 × ·25, *sacculus* ·1–·12, *cellulæ* $\frac{1}{50}$–$\frac{1}{40}$; *bracteæ* 1·25 × 0·7; *perianthia* 2·5 × ·65–·70 mm.

Hab. Super *Aneuram* sp., in crateris Grande Souffrière dicti margine insulæ Dominicæ (Elliott, no. 886, Dec. 1892).

Obs. The typical form of this species was gathered in Cuba by the late Mr. C. Wright, and the specimens were issued after his death, under Gottsche's MS. name by Prof. Asa Gray, in 1886. It differs from the Dominican variety in the leaves being more spinose, the sinus rather shallower and less rounded, and the shorter segments—less incurved and horn-like.

Genus 8. Alobiella, *Spruce.*

92. A. Husnoti, *Gottsche, in Rev. Bry.* 1875, p. 3; *Journ. de Botanique*, 1893, p. 187.—Dominica, Morne Anglais (494), Morne Trois Pitons (490, 718).—This species was gathered by me in 1855 in the Peruvian Andes and by M. Husnot in Guadeloupe. Mr. Elliott's specimens possess perfect perianths. The following species is new and very distinct.

93. Alobiella dominicensis, *Spruce*, n. sp. (Tab. XXVI. figs. 5–9.)

Dioica, pusilla, tenera, albicans, in plagas latas effusa; *caules* vix semipollicares, assurgentes, parum ramosi, interdum flagelliferi. *Folia* patentia, dissita, florem ♀ versus confertiora majoraque, ovata ovatove-lanceolata, obtusata, raro retusula, rarissime obtuse bidentata; *cellulæ* pellucidæ pachydermes, inferiores magnæ sublineares, superiores duplo fere minores et breviores. *Flores* ♀ terminales; *bracteæ* obscure tristichæ, 2–3-seriatæ, foliis dimidio longiores, apice sæpe obtuse 3–4-dentatæ. *Perianthia* (immatura) emersa, late linearia, trigona, truncata, ore inæqualiter laciniato-dentata.—*Folia* ·65 × ·35, *cellulæ inferiores* $\frac{1}{12}$, *superiores* $\frac{1}{16}$–$\frac{1}{20}$; *bracteæ* ·9–1·1; *perianthia* 1·3 × 0·6 mm.

Hab. Dominica, Laudat, in Valle Roseau, ad terram (Elliott, no. 67, 81, 82, Junio 1892).

Genus 9. Odontoschisma, *Dum.*

94. O. prostratum, *Spruce*. *Sphagnœcetes prostrata*, Nees, in Syn. Hep. p. 149.—Dominica, Morne Diablotin (665, 680), Morne Couronne (233).

Genus 10. Adelanthus, *Mitt.*

95. A. decipiens, *Mitt.* Var., *Spruce, in Journ. Bot.* 1876, p. 196.—Dominica, Morne Diablotin (653, 658, 659, 660).

Of this species, first gathered in Ireland by Miss Hutchins, but only the male plant, Mr. Elliott gathered copious and luxuriant but sterile specimens. The fertile plant had been gathered in Cuba by Wright, and in the Quitenian Andes by myself in 1857. The American form has rather rounder leaves, less sharply toothed than the European, but I find no other difference. Mr. Elliott did not succeed in finding a second Dominican species—*A. decurvus*, Mitt. (Spruce in 'Journ. Bot.' 1876, p. 199; Hep. Amaz. p. 406), of which the Rev. L. Guilding had gathered the female plant in that island, and I the male plant in the Peruvian Andes in 1855.

Genus 11. Kantia, *Gray.*

96. K. portoricensis, *Steph. in Hedwigia*, 1888, p. 280 (=*K. vincentina*, H. Wright, in Journ. Bot. 1891, p. 106).—

St. Vincent, Mt. St. Andrews (65, 88), Souffrière (45), Richmond Peak (209). Dominica, Morne Diablotin (645), Morne Trois Pitons (764).

§ 2. *Lepidozieæ*.

Genus 12. LEPIDOZIA, *Dum.*

97. L. PATENS, *Lindenb. in Syn. Hep.* p. 202.—Dominica, Roseau Valley (59).

Of *Lepidozia* Mr. Elliott gathered but one species—the microphyllous *L. patens*, which occurs also in the French Antilles.

Genus 13. BAZZANIA, *Gray* (=Mastigobryum, *Nees*).

No new species of *Bazzania* was found. Three at least of the following seven species—*B. vincentina*, *B. Breutelii*, and *B. arcuata*—extend along the eastern slopes of the Andes to a few degrees S. of the Equator.

98. B. VINCENTINA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 377. —St. Vincent, Mt. St. Andrews (63). Dominica, Morne Micotrin (97, 99), Morne Couronne (218).

99. B. BREUTELII, *Spruce*; *Steph. in Hedwigia* (1888), p. 300.—Dominica, Morne Micotrin (94), Roseau Valley (96), Morne Diablotin (678).

100. B. SUBFALCATA, *Spruce*. *Mastigobryum subfalcatum*, Steph. in Hedwigia, 1886, p. 234.—Dominica, Morne Diablotin (678).

101. B. ARCUATA, *Spruce*. *Mastigobryum arcuatum*, Lindenb. et Gottsche, in Syn. Hep. p. 718.—Dominica, Morne Micotrin (95), Morne Trois Pitons (728).

102. B. FALCATA, *Spruce*. *Mastigobryum falcatum*, Lindenb. in Syn. Hep. p. 231.—St. Vincent, Souffrière (226).

103. B. KRUGIANA, *Steph. in Hedwigia*, 1888, p. 300.—(*Exempl. unicum in* Plagiochila *repens*.)

104. B. LONGA, *Spruce*. *Mastigobryum longum*, Nees, in Syn. Hep. p. 231.—Dominica, Morne Diablotin (672).

Genus 14. MICROPTERYGIUM, *Nees*.

This genus is represented by a solitary species gathered by Mr. Elliott in several stations in the mountains of Dominica. It had previously been found in Porto Rico by Sintenis and described by Stephani.

105. MICROPTERYGIUM PORTORICENSE, *Steph. in Hedwigia*, 1888, p. 294. (Tab. XXVII. figs. 1–4.)—Dominica, Morne Micotrin (104), Morne Diablotin (664, 667), Morne Trois Pitons (726), Grande Souffrière (845).

Subtribus iv. *JUNGERMANNIDEÆ.*

Genus 15. LOPHOCOLEA, *Dum.*

There are only three species of *Lophocolea*, all rather scanty and meagre. *L. Martiana*, a large and conspicuous species, is widely distributed in tropical America, but exists in the greatest profusion and beauty on prostrate and decaying trunks in the forests of the Amazon, where flakes large enough for a moderate tablecloth may sometimes be torn away in a piece.

106. L. MARTIANA, *Nees, in Syn. Hep.* p. 152.—St. Vincent, Richmond Peak (216). Dominica, Morne Micotrin (69, 98), Morne Diablotin (643), Roseau Valley (76) var., Morne Couronne (226).

107. L. CONNATA ?, *Nees, in Syn. Hep.* p. 153.—Dominica, Morne Trois Pitons (738).

108. L. BREUTELII, *Gottsche, in Syn. Hep.* p. 154.—Dominica, Roseau Valley (76).

Genus 16. LEIOSCYPHUS, *Mitt.*

Of this genus Mr. Elliott gathered two species, both apparently new to the Antilles, although one of them, *L. Jackii*, Steph., had previously been gathered on the 'paramos' of New Granada by the late G. Wallis and described by Stephani. It is a fine large species, of a deep red-brown colour, and is notable for its pitcher-shaped perianth and its large and curiously cut stipules. Mr. Elliott got well-fruited specimens in three localities. The second species, *L. ovatus*, is hitherto undescribed. It is a smaller species than *L. Jackii*, of much the same colour except the perianth, which (curiously enough) is always green.

109. L. JACKII, *Steph. in Hedwigia*, 1892, p. 21.—St. Vincent, Souffrière (47). Dominica, Roseau Valley (58, 65), Morne Diablotin (657), Morne Trois Pitons (740).

110. L. OVATUS, *Spruce*, n. sp. (Tab. XXVII. figs. 5–9.)

Dioica, rufo-badia, depresso-cæspitosa; *caules* 3 cm. alti, in-

tricati, vage ramosi. *Folia* opposita, subimbricata, subplana, suboblique ovata, late obtusata, repanda; *cellulæ* sat magnæ, ovales, convexæ, pellucidæ, trigonis angularibus auctæ. *Foliola* duplo breviora, appressa, oblonga vel subobovata, ad ½ bifida, sinu lato lunato, segmentis tenuicuspidatis, utrinque supra basin hastatim unispinis, ipsa basi cum foliis brevissime connata. *Flores* ♀ terminales; *bracteæ* laxæ, foliis vix diversæ, paullo breviores et latiores; *bracteola* foliolis conformis. *Perianthia* alte emersa, exacte oviformia, pallida, fragilia, inflata, solum apicem subconstrictum laticrenatum versus subcompressa. *Calyptra* (juvenilis) obovata.—*Folia* 1·5 × 1·2, *cellulæ* $\frac{1}{16}$; *foliola* ·8 × ·4 (*sine spinis*); *perianthia* 3·0 × 2·0–1·8 mm.

Hab. Dominica, in monte Trois Pitons dicto, ad arbores (ELLIOTT, no. 772, Nov. 1892).—Affinis *L. Chamissonis* (L. et G.), distincta tamen forma foliorum, cellulis magnis, perianthio turgido, ore constricto, etc.

Genus 17. PLAGIOCHILA, *Dum.*

Plagiochila, as was to be expected, is in great force. I enumerate 21 species collected by Mr. Elliott, rather more species having occurred in St. Vincent than in Dominica, which is contrary to the proportion in most other genera. Of the whole number only one appears to be quite new, and I have ventured to dedicate it to Mr. Elliott. The rest all occur in other West Indian islands. A very few spread along the Andes to the Equator, but, so far as I know, only a single species reaches the southern tropic.

§ 1. *Spinulosæ.*

111. P. GYMNOCALYCINA, *Mont. et Nees, in Syn. Hep.* p. 32.—Dominica, Roseau Valley (63, 64, 65).
Var.—St. Vincent, Souffrière (46), Mt. St. Andrews (65).

112. P. GUADALUPENSIS, *Gottsche, in Rev. Bry.* 1875, p. 2; *Journ. de Botanique*, 1893, p. 189.—Dominica, Morne Diablotin (655, 670).

113. P. CONFUNDENS, *Gottsche, in Linnæa*, 1852, p. 337.—St. Vincent, Bonhomme Valley (94). Dominica, Morne Couronne (211), male plants.

114. PLAGIOCHILA BICORNIS, *Hampe et Gottsche, in Linnæa*, 1852, p. 338; *Hedwigia*, 1888, p. 296.—Dominica, Morne Micotrin (99).

115. P. BIDENS, *Gottsche, in Ann. Sc. Nat.* Sér. IV. viii. p. 322.—Dominica, Morne Trois Pitons (721, 722), Morne Diablotin (700), a var.

116. P. TENUIS, *Lindenb. in Syn. Hep.* p. 32.—St. Vincent, Mt. St. Andrew's (67), Bonhomme Valley (91). Dominica, Morne Couronne (215)—a var.?

117. P. DIVA'RICATA, *Lindenb. in Syn. Hep.* p. 30.—Dominica, Morne Micotrin (68), Morne Trois Pitons (723).

118. P. REMOTIFOLIA, *Hampe et Gottsche, in Linnæa*, 1852, p. 340.—St. Vincent, Grand Bonhomme mtn. (92). Dominica, Morne Couronne (213).

119. P. PERROTTETIANA, *Mont. et Gottsche, in Ann. Sc. Nat.* Sér. IV. vi. p. 195.—Dominica, Morne Micotrin (100), and perhaps Morne Diablotin (682).

120. P. SIMPLEX, *Lindenb. in Syn. Hep.* p. 30.—St. Vincent, Morne Garu (51).

121. P. BURSATA, *Lindenb. in Syn. Hep.* p. 33.—Dominica, Morne Diablotin (640).

Var.—St. Vincent, Mt. St. Andrews (64), Souffrière (96).

§ 2. *Adiantoideæ* s. *Grandifoliæ*.

122. P. ADIANTOIDES, *Lindenb. in Syn. Hep.* p. 38.—Dominica, Morne Diablotin (674).

123. P. DOMINICENSIS, *Tayl. in Hook. Lond. Journ. Bot.* vii. p. 270, *et in Syn. Hep.* p. 642.—Dominica, Morne Micotrin (101), Morne Diablotin (655).

124. P. SUPERBA, *Lindenb. in Syn. Hep.* p. 39.—St. Vincent, Bucament Valley (205). Dominica, Morne Micotrin (103).

125. P. ELLIOTTII, *Spruce*, n. sp. (Tab. XXVIII. figs. 1–5.)

Dioica, elata, virescens, cæspitosa; *caules* 3-pollicares, validi, semel bisve dichotomi. *Folia* distiche patentia, subopposita vel alterna, basi brevi spatio imbricata, superne dissita, oblique semicordato-ovato-oblonga, apice oblique truncato pauci-(1–4-) denticulata—raro rotundata vel abrupte acuta—margine antico

leviter recurvo longe decurrentia integerrima, rarius subdenticulata, postico apicem versus 2–4-denticulata vel calva, medio setulis 1–4 armata, basi decurrenti-amplexante recurva crebrius setulosa ciliolatave (setis sub 12); *cellulæ* parvulæ, subpellucidæ, trigonis vix ullis. *Flores* ♀ in dichotomiis; *bracteæ* foliis æquimagnæ, magis ovales, margine postico toto spinulosæ. *Perianthia* (juvenilia) compresso-campanulata, hinc brevi spatio anguste subalata, ore rotundato spinuloso.—*Folia* 3·3 × 2·0–2·5, *cellulæ* $\frac{1}{36}$ mm.

Hab. Ins. Dominica, ad arbores in monte Micotrin, alt. 2000–4000 ped. (ELLIOTT, no. 102, Junio 1892), in monte Trois Pitons (ELLIOTT, no. 717). Ins. S. Vincentii, in m. Sti. Andreæ (ELLIOTT, no. 63, Feb. 1892).—Ab icone *P. abruptæ* Lindenbergii, Sp. Hepat. p. 106, tab. 20, distat foliis basi postica crebre ciliolatis (nec calvis) *.—Planta *P. Elliottii* e Dominica folia magis dentata habet; Vincentina foliis, basi apiceque exceptis, sæpe integerrimis gaudet. Alia differentia non adest.

126. PLAGIOCHILA VINCENTINA, *Lindenb. in Syn. Hep.* p. 41.—St. Vincent, Bucament Valley (205), Bonhomme Valley (90).

127. P. BREUTELIANA, *Lindenb. in Syn. Hep.* p. 41.—St. Vincent, Souffrière, Mt. St. Andrews (225).

Var. GUADALUPENSIS, *Gottsche.*—St. Vincent, Richmond Valley (220). Dominica, Morne Micotrin (106).

128. P. SUBPLANA, *Lindenb. in Syn. Hep.* p. 37, var. LIGULIFOLIA, *Spruce.*—St. Vincent, Richmond Valley (222).

§ 3. *Cristatæ.*

129. P. CRISTATA, *Lindenb. in Syn. Hep.* p. 46, forma pauper? —St. Vincent, Mt. St. Andrews (65).

130. P. HYPNOIDES, *Lindenb. in Syn. Hep.* p. 45.—St. Vincent, Gibson mt. (3).

131. P. AFFINIS, *Lindenb. et Gottsche*?, *in Syn. Hep.* p. 644.—St. Vincent, Richmond Valley (206), Richmond Estate (349).

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* Mr. Gepp has kindly sketched for me the leaves of an original specimen of Lindenberg in Hampe's herbarium, which shows them narrow and entire at the base; not ciliate, semicordate, and widely overpassing the stem as in *P. Elliottii*; less toothed at the lateral margins and more truncate at the apex.

Genus 18. SYZYGIELLA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 499.

Of *Syzygiella* there is only a single species, a nearly smooth-leaved form of the *Jungermannia perfoliata* of Swartz. I had previously known this species as very rough-leaved, but seeing the leaves scarcely at all tubercular and slightly different in outline, I at first took it for a distinct species. Like every other *Syzygiella* it has extraordinarily large trigones at the angles of the leaf-cells, in which it agrees with *Leioscyphus*—another genus with similar opposite leaves, but differing in the constant presence of large stipules, and in the smooth (not numerously-plicate) perianth, flattened at least towards the truncate apex.

[Mr. Spruce's MS. contains an abbreviated note on synonymy of *Syzygiella*, which I interpret as follows:—*Plagiochila anomala*, Lindenb. et Gottsch. in Syn. Hep. (1847) p. 646, was figured by Gottsche in 1863 in his 'Mexikan. Leverm.' t. 7. On p. 63 of the latter work Gottsche says that the leaves appear "interdum bidentata." Mr. Spruce considers the plant to be identical with his own *Syzygiella plagiochiloides* var. *subintegra* described in Trans. Bot. Soc. Edinb. xv. p. 501, with the leaves "raro oblique bidentellis"; and he would institute the name *Syzygiella anomala*, Spruce. Further the var. *densifolia* of *S. plagiochiloides* (loc. cit. p. 501) is identical with *Chiloscyphus mancus*, Mont., 'Sylloge' (1856), p. 63, and (?) with *Plagiochila subintegerrima*, Nees, in Lindenberg's 'Species Hepaticarum' (1839), p. 129, t. 28. Mr. Spruce's note goes on to say "fig. 6 ej. tab. aliena, Plag. vera (Nees, Hep. Jav. 79) Mont. f. per paria approx. Java (*Blume*), Bolivia (*D'Orb.*)." By this I understand that Lindenberg's tab. 28. fig. 6 represents a portion of an entirely different species, a true *Plagiochila*, which seems likely enough, for the leaves are not subentire but spinoso-dentate, and the perianth is clavato-obovate, and not ovate, turgid, constricted at the apex as in a *Syzygiella*. Indeed I would venture to suggest that fig. 6 belongs to *Plagiochila bahiensis*, Lindenb., which is figured immediately above it on the same plate. It is true that the perianth of that species is omitted in the description (p. 136) as unknown. Perhaps that is another mistake. On the other hand, Montagne describes the Bolivian plant in D'Orbigny's 'Voyage dans l'Amérique méridionale' (1835), p. 80, as "foliis per paria approximatis . . . . . subintegerrimis, perianthiis ovatis compressis, ore truncato ciliato"—a description which fits Mr. Spruce's

Syzygiella plagiochiloides var. *densifolia* except in the compression of the perianth. Possibly the two plants may prove to be the same species. As to Nees's Javan plants, judging from specimens in Herb. Hampe preserved in the British Museum, one is justified in referring them to the genus *Syzygiella*, but not to *S. plagiochiloides*, from which *S. subintegerrima* differs widely in habit and in cell-structure. The trigones at the angles of the cells do not attain that remarkable development which is exhibited in *S. plagiochiloides*. The perianth is large, turgid, longly elliptical, and at the apex plicate and plurifid. The leaves (and also the male bracts) are as figured in Lindenberg's plate, but at the postical base are rather widely connate, the margin of the connate bases being distinctly reflexed, and beneath them tufts of radicles spring from the stem. It is noteworthy that the plant originally described as *Plagiochila subintegerrima* in 'Nova Acta,' xii. (1824), p. 238, is the var. β of Nees's 'Enumeratio plant. Crypt. Javæ,' 1830, p. 39, and of succeeding works. There is no specimen of D'Orbigny's plant in the British Museum. I see in 'Hedwigia,' 1893, p. 327, under *Syzygiella manca*, that Herr Stephani considers *S. plagiochiloides* and *Chiloscyphus mancus* to be synonymous.—A. G.]

132. Syzygiella perfoliata, var. lævigata, *Spruce* (S. longicaulis, *Spruce, MS.*). (Tab. XXVIII. figs. 6–9.)

Dioica, olivacea, cæspitosa; *caules* 7–8 cm. alti, sæpe arcuantes, inferne dichotome ramosi, ramis fastigiatis longe simplicibus æquifoliatis. *Folia* opposita, patentia vel subsecunda, inferiora dissita, superiora imbricatula, fere transversim inserta, utraque basi cum contrariis contigua vel leviter connata, ovato-ovalia rotundata, plana vel subconcava, repanda; *cellulæ* parvulæ, subpellucidæ, convexulæ, trigonis angularibus auctæ. *Flores* nullos inveni.—*Folia* 1·0–1·2 × ·75, *cellulæ* $\frac{1}{36}$ mm.

Hab. Dominica, in monte Diablotin, ad arbores (Elliott, no. 651, Oct. 1892).—*Jung. oppositifolia* nob. in "Hepat. Bolivianæ" (Mem. Torrey Bot. Club, i. p. 138), quæ etiam vera *Syzygiella* est, distat a præcedente statura duplo minore, foliis late oblongis, cellulis scabris.

Genus 19. Jungermannia, *Rupp.*

Of the three species, one (*J. dominicensis*) is new—a minute species with round leaves, in size and character near the *J. amœna* of Lindenb. & Gottsch., found by Liebmann in Mexico and by

myself in the Peruvian Andes, but differing from this and other species in the truly autoicous inflorescence, every other *Eujungermannia* being either dioicous or paroicous. The third species, *J. schistophila*, is so distinct in habit and in the minute bifid, obtusilobed leaves that I proposed for it in the 'Hepat. Amaz.' p. 511 the subgeneric name *Cephaloziopsis*. Perfect perianths are rare, but are certainly 5-gonous at the apex. In the Peruvian Andes it grows on argillaceous schist, in the Quitenian Andes on mica. Mr. Elliott's specimens grew long drawn-out in a stream and on wet rocks and banks in the crater of the Grande Souffrière, Dominica.

133. JUNGERMANNIA CALLITHRIX, *Lindenb. et Gottsche, in Syn. Hep.* p. 673.—St. Vincent, Mt. St. Andrew's (233).

134. J. DOMINICENSIS, *Spruce*, n. sp. (Tab. XXIX. figs. 1–3.)

Monoica, minutula, in plagas latas effusa; caule 3 mm. longo, basi rhizomatoso subdiviso prostrato radicelloso, deinde assurgente simplice vel ramum unum alterumve proferente, inferne subaphyllo. *Folia* dissita, luride rufescentia, novella virentia, oblique vel transverse fere inserta, recurvo-patula, ovali-orbiculata, apice rotundata raro retusa; *cellulæ* subopacæ, minutulæ, æquilateri-hexagonæ, marginales concolores quadratæ. *Flores* ♀ terminales, innovatione (interdum ♂) suffulti, vel non; *bracteæ* appressæ, foliis subconformes, duplo tamen majores. *Perianthia* alte exserta, cylindrico-fusiformia, apice acuto 4–5-carinata, lævia. *Andrœcia* longispica, plerumque totum ramum sistentia; *bracteæ* julaceo-imbricatæ, orbiculatæ, concavæ, monandræ.—*Folia* $\cdot 3 \times \cdot 25$, $\cdot 3 \times \cdot 3$, *cellulæ* $\frac{1}{60}$; *perianthia* $1\cdot 0 \times 0\cdot 3$ mm.

Hab. Dominica, Roseau Valley, in terra umbrosa (ELLIOTT, no. 78, Junio 1892). Sti. Vincent, Richmond Valley (ELLIOTT, no. 174).—*J. crassula*, M. et Nees, in Brasilia et Juan Fernandez lecta, nostræ subsimilis, folia habet ovata concava, et perianthia multo breviora, ovata inflata et obtusa. *J. coniflora*, Schiffn. (Hep. 'Gazelle'-Reise), p. 10, t. 2, habitu etc. nostræ subsimilis, quadruplo major est, foliis triplo majoribus suberectis, perianthiis ecarinatis hinc profunde unisulcis—ad *J. pumilæ*, With., instar, cui affinis videretur.

135. J. SCHISTOPHILA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 513. (Tab. XXIX. figs. 4–6.)—Dominica, Grande Souffrière (858, 859, 860, 861).

Genus 20. ALICULARIA, *Corda*?

To *Alicularia* (=*Nardia*, Gray & Lindberg ex parte) I now refer, but doubtfully, the curious *Jungermannia succulenta*, Rich., of which Mr. Elliott gathered numerous specimens, thickly encrusted with the mineral deposits of the Grande Souffrière of Dominica, where it grew along with *Isotachis serrulata.* In the Trans. Bot. Soc. Edinb. xv. p. 519, I proposed for it the subgeneric name *Apotomanthus*, from the truncate, obtusely trigonous, emersed perianth, in which it is certainly very different from the immersed, 5-gonous, microstomous perianth of *Alicularia scalaris*, Cord., and its allies.

136. A. SUCCULENTA, *Spruce. Jungermannia succulenta*, Lehm. & Lindenb. in Syn. Hep. p. 84.—Dominica, Grande Souffrière (835, 836, 837, 838, 839, 840, 841, 842, 843, 850, 864, 869).

Genus 21. TYLIMANTHUS, *Mitt.*

Of this genus Mr. Elliott gathered all the three species published by Lindenberg, as species of *Plagiochila*, in the 'Species Hepaticarum.' Unfortunately they are all sterile, and therefore do not show the saccate perianth characteristic of the genus.

137. T. LAXUS, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 502. *Plagiochila laxa*, Lindenb. in Syn. Hep. p. 35.—St. Vincent, Mt. St. Andrew's (65). Dominica, Morne Diablotin (676).

138. T. APPROXIMATUS. *Plagiochila approximata*, Lehm. & Lindenb. in Syn. Hep. p. 49.—Dominica, Morne Diablotin (675).

139. T. AMPLEXIFOLIUS. *Plagiochila amplexifolia*, Hampe, in Syn. Hep. p. 49.—Dominica, Roseau Valley (73).

Subtribus v. *FOSSOMBRONIEÆ.*

Genus 22. SCALIA, *Gray* (=HAPLOMITRIUM, *Nees*).

140. S. ANDINA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 532 (=Haplomitrium andinum ejusdem MS. 1856=*H. mnioides*, Gottsche, in Besch. 'Hépatiques des Antilles Françaises,' 1893). (Tab. XXX. figs. 1–6.)—Dominica, Morne Micotrin (85), Morne Trois Pitons (767).

This fine hepatic, a very near ally of our British *Jungermannia Hookeri*, Sm., but thrice the size, was gathered by me in the Peruvian Andes in July 1856, and named at the time as above.

I can now safely assert that the Peruvian plant and the West-Indian are the same species, Mr. Elliott's specimens gathered in two localities in Dominica agreeing perfectly with mine.

Genus 23. SYMPHYOGYNA, *Mont.*

Of the two *Symphyogynæ* gathered by Mr. Elliott, one is new and is remarkable for the costa of the frond being traversed by three dark ligneous bands or threads. Unfortunately it is sterile.

141. S. SINUATA, *Mont. et Nees, in D'Orbign. Voy.* p. 61, *et in Syn. Hep.* p. 482.—Dominica, Morne Trois Pitons (693, 765).

142. S. TRIVITTATA, *Spruce*, n. sp. (Tab. XXX. figs. 7–11.)

Dioica, in ipsa basi ramosa; *frondes* 2½–8 cm. longas, lineari-lanceolatas, undulatas, virentes, margine subrufo repando integerrimo, plerumque simplices, raro frondulam anticam emittentes, proferens. *Costa* frondis sat valida, sectione lanceolata, filis vittisve tribus—raro superne solum duabus—tenuibus nigrescentibus ligneis percursa; *limbus* unistratus, cellulis magnis æquilateris constans. *Flores* ♀ facie frondis antica orti; *calyptra* (juvenilis) cylindrica, apice pistillidia plurima gerens, basi ad *S. brasiliensis* instar involucrata.—*Frons* 5 mm. *lata, cellulæ* $\frac{1}{12}$ mm.

Hab. Dominica, ad saxa humida montis Micotrin (ELLIOTT, no. 86, Junio 1892), etiam in monte Trois Pitons (ELLIOTT, no. 774, 887, Nov. 1892), et in Monte Diablotin (ELLIOTT, no. 695).—*S. brasiliensis* minor est, costa frondis solum univittata.

Genus 24. BLYTTIA, *Endlich.*

143. B. LYELLII, *Endl. in Syn. Hep.* p. 475, var.?—Dominica, Grande Souffrière (871, 872).

Genus 25. MONOCLEA, *Hook.*

144. M. FORSTERI, *Hook. Musc. Exot.* t. 174.—St. Vincent, Richmond Valley (194), on rocks; Hermitage Woods (187). Dominica, Morne Trois Pitons (887), Morne Diablotin (696).

This plant is a curious instance of a large frondose hepatic discovered by G. Forster (on Captain Cook's second voyage, 1772–75) in the Australian Islands, having since been found to extend throughout the entire length of South America; nor has anyone hitherto been able to separate the West-Indian and South-American from the Australasian plant specifically.

A few years ago some fern-roots from New Zealand reached Backhouse's nursery at York, and on them grew an unknown frondose hepatic. It was sterile but throve well in its new home. Mr. Webster, the manager, watched it sedulously; but some years elapsed ere it showed signs of flowering and at length produced a single perfect fruit, which he sent to me. This proved the plant to be the *Monoclea leptohymenia*, Tayl., "Hepat. Antarct." in Lond. Journ. Bot. 1844, p. 575 = *Dendroceros leptohymenius*, Synops. Hepat. 1847, p. 580, "Columella tenuissima, nec nisi ope lentis observanda." It is a true *Monoclea*, with all the characters of that genus; involucres, follicular capsule, bispirous elaters, &c., all as in *M. Forsteri*, but the frond much broader and thinner. Taylor's description is accurate enough, except as to the "columella tenuissima" &c.; for there is no columella, and what has been taken for one has probably been a thread-like strip split off the edge of the follicular capsule in dehiscence.

Subtribus vi. *METZGERIEÆ.*

Genus 26. ANEURA, *Dum.*

Of *Aneura* I enumerate 9 species. Those I propose as new seem distinct enough, but are unfortunately most of them sterile. There may even be two or three additional species, attached to other hepatics, but the plants are too fragmentary to describe.

145. A. FUCOIDES. *Metzgeria fucoides*, Nees, Lindenb. et Gottsche, in Syn. Hep. p. 506.—Dominica, Morne Trois Pitons (741, 761).

146. A. DIABLOTINA, *Spruce*, n. sp.

Dioica, e rufo olivacea; *frondes* 1–2 cm. altæ, e caudice repente ortæ, bipinnatæ, caule primario exalato, sectione ovali; pinnæ pinnulæque oppositæ, late alatæ, costa pinnarum 5 cellulas crassæ; pinnulæ densæ, lineares vel sublanceolatæ, alis 4–5 cell. latis, costâ 3–4 cell. opertâ, 3 cell. crassâ, margine repandæ, apicem versus obsolete denticulatæ, apice retusæ vel (superiores præcipue) attenuatæ hamatæque; *cellulæ* alarum majusculæ, ($\frac{1}{24}$ mm.) subæquilateræ, pachydermes, trigonis angularibus auctæ.

Flores ♀ binati, sæpe in pinna brevi terminales. Cetera haud visa.

Hab. Dominica, ad arbores in monte Diablotin (ELLIOTT, no. 699, Oct. 1892).—Ab affinibus distat præcipue angulis cellularum incrassatis. *A. pectinata*, Hep. Amaz., huic habitu similis, flores habet monoicos, trigona cellularum nulla, etc.

147. ANEURA LATICOSTATA, *Spruce*, n. sp.

Dioica, rufescens; *frondes* 3 cm. altæ, bipinnatæ, trunco primario subplano-convexo, millimetrum lato, medio 12–14 cellulas crasso, peranguste hic illic subulato; pinnæ pinnulæque oppositæ, alatæ, hæ lineares vel sublanceolatæ, obtusæ retusulæve, repandæ, costa prælata, cellulis corticalibus 16-seriatis operta, medio 5 cell. crassa, limbo utrinque cellulis unistratis 4–5-seriatis æquilateris constante. *Flores* ♀ axiales, binati, laciniis longis involucrati; *calyptra* subtuberculosa (juvenilis solum visa).—*Cellulæ alarum* $\frac{1}{24}$ mm.

Hab. Ad truncos vetustos in monte Diablotin insulæ Dominicæ (ELLIOTT, no. 698, Oct. 1892).—*A. diablotina*, in eodem monte lecta, duplo minor est, trunco frondis omnino exalato, costa pinnularum solum 3–4 cellulas lata, cellulis limbi ad angulos incrassatis.

148. A. HYMENOPHYTOIDES, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 549.—St. Vincent, Richmond Valley (223).

149. A. SCHWANECKEI, *Steph. in Hedwigia*, 1888, p. 278.—St. Vincent, Richmond Peak (208). Dominica, Morne Couronne (226), male plant (forsan sp. alt.).

150. A. DISTANS, *Spruce*, n. sp.

Dioica; *frondes* 5 cm. altæ, bipinnatæ, caule nigro, ovali-tereti, vimineo, exalato; *pinnæ* distantes, oppositæ, alatæ, basi tamen subexalatæ; *pinnulæ* paucæ, alternæ, distantes, planæ, anguste lineares, apice sublatiores, retusæ emarginatæve, margine repandæ apicem versus subdenticulatæ; costa pinnarum medio 5 cellulas, pinnularum 3 cellulas crassa, cellulis sub 4-seriatis operta; *cellulæ* majusculæ, hexagonæ, trigonis nullis, ad alas 5–7-seriatæ. *Flores* . . . .—*Pinnæ* 7–10 mm. *longæ*, *pinnulæ* 2–4 mm.

Hab. Dominica, in monte Trois Pitons dicto, ad arbores vetustos (ELLIOTT, no. 763, Nov. 1892).

151. ANEURA STIPATIFLORA, *Steph. in Hedwigia*, 1893, p. 27.—Dominica, Morne Diablotin (697), Morne Trois Pitons (762, 766).

152. A. PLANIFRONS, *Spruce*, n. sp.

Dioica, plana, matrici adpressa, fronde lata, tenui, pinnata, pinnis dissitis, brevibus, linearibus rotundatis v. superne angustatis, simplicibus furcatisve, tam fronde quam pinnis prælate costatis, costa solum 2 v. 3 cellulas crassa, limbo angusto unistrato, solum cellulis 3–4-seriatis constante, circumdatis; *cellulæ* magnæ subæquilateræ, marginales duplo minores. *Flores* ♀ pinna brevi insidentes, squamis laciniatis involucrati. *Calyptra* . . . .—*Frons* 3×1·0–1·2 cm.; *cellulæ limbi* $\frac{1}{12}$, *marginales* $\frac{1}{24}$ mm.

Hab. Ins. Sti. Vincentii, in monte Sti. Andreæ, ad Musarum vaginas marcescentes (ELLIOTT, no. 145, Febr. 1892).

153. A. DILATATA, *Spruce*, n. sp.

Dioica, sordide viridis; *frondes* vix centimetrum longæ, procumbentes et imbricatæ, ambitu late oblongæ, irregulariter breviterque fissæ, interdum subpinnatifidæ, basi 2 mm. latæ planæ, segmentis oblongis cuneatisve, ubique carnosis, 2–5-stratis, præter in ipso apice lato, rotundato, retuso, tricrenatove, cellulis uniseriatis parvulis vacuis quadratis rectangularibusve albido-marginato; ceteræ cellulæ paullo majores, oblongo-hexagonæ, corticales tenues, interiores sat crassæ. Alia segmenta frondis linearia, apice gemmipara, rarius occurrunt; flores haud inveni.—*Cellulæ marginales* $\frac{1}{32}$–$\frac{1}{40}$ mm.

Hab. Dominica, in monte Diablotin, ad saxa (ELLIOTT, no. 683, 694, Oct. 1892); Roseau Valley (ELLIOTT, no. 77). Plantula singularis, facie *Anthocerotis Collematisve* potius quam *Aneuræ*. Forsan *A. albomarginatæ*, Amboynensi, a cl. Stephani descriptæ ('Hedwigia,' 1893, p. 17) subaffinis.

Genus 27. METZGERIA, *Raddi*.

154. M. PLANIUSCULA, *Spruce, in Rev. Bry.* 1888, pp. 34, 35 (nomen nudum).—St. Vincent, Bonhomme Valley (86, 144). Dominica, Morne Micotrin (105), Morne Couronne (232).

[The fronds are 1·5 mm. or more wide, and absorb water slowly; the margins are crenulate, and, like the midrib, bear root-hairs; cells 0·057 mm. The original specimens in Herb. Spruce have narrower fronds (1·0 mm. or less) with entire margins; Glaziou

no. 7394 (Brazil) has root-hairs scattered over the whole under-surface, and cells 0·028 mm. wide; Balansa no. 4334 (Paraguay) has root-hairs beneath the midrib and margins, but rarely on lamina, cells 0·041 mm. wide.—A. G.]

155. METZGERIA LEPTONEURA, *Spruce, in Trans. Bot. Soc. Edinb.* xv. p. 555.—St. Vincent, Richmond Peak (217).

Var.—Dominica, Morne Trois Pitons (725).

Subordo II. MARCHANTIACEÆ.

Genus 28. DUMORTIERA, *Nees.*

156. D. HIRSUTA, *Reinw., Blume et Nees, in Syn. Hep.* p. 543.—St. Vincent, Richmond Valley (194). Dominica.

This species grows along with *Monoclea* in both the islands at a moderate elevation; as it does also in the Peruvian Andes, where neither species ascends above a thousand metres.

Genus 29. MARCHANTIA, *Mich.*

157. M. CHENOPODA, *Linn. Sp. Pl.* ed. I. 1137—St. Vincent, Kingstown (232). Dominica, Roseau Valley (61).

Though Mr. Elliott's collections contain only this, the common montane species of tropical America, it is probable that other species exist in the two islands.

Subordo III. RICCIACEÆ.

Genus 30. RICCIA, *Mich.*

158. R. GLAUCA, *Linn. Sp. Pl.* ed. I. 1137, var. ?—Dominica, Roseau Valley (500).

To this species, as a large form, I refer the only specimens of this genus collected; but they may be distinct.

Subordo IV. ANTHOCEROTACEÆ.

Genus 31. DENDROCEROS, *Nees.*

159. D. CRISPATUS, *Nees, in Syn. Hep.* p. 579.—St. Vincent, Richmond Valley (224), on rocks.

160. D. CRISPUS, *Nees, in Syn. Hep.* p. 581.—Dominica, Grande Souffrière (870).

Fertile specimens of both species were gathered. *D. crispatus* is well figured by Hooker in the 1st vol. of his 'Botanical Miscellany,' tab. 27.

Genus 32. ANTHOCEROS, *Mich.*

161. A. TUBERCULATUS, *Lehm. et Lindenb. in Syn. Hep.* p. 585.—St. Vincent, Chateau Belair (231). Dominica, Emsol Estate (499).

162. A., sp. (sterilis).—Dominica, Roseau Valley (79).

A. tuberculatus was found in both islands fruiting abundantly. And what seems to be a second species, but sterile and in small quantity, was gathered in Dominica.

EXPLANATION OF THE PLATES.

PLATE XX.

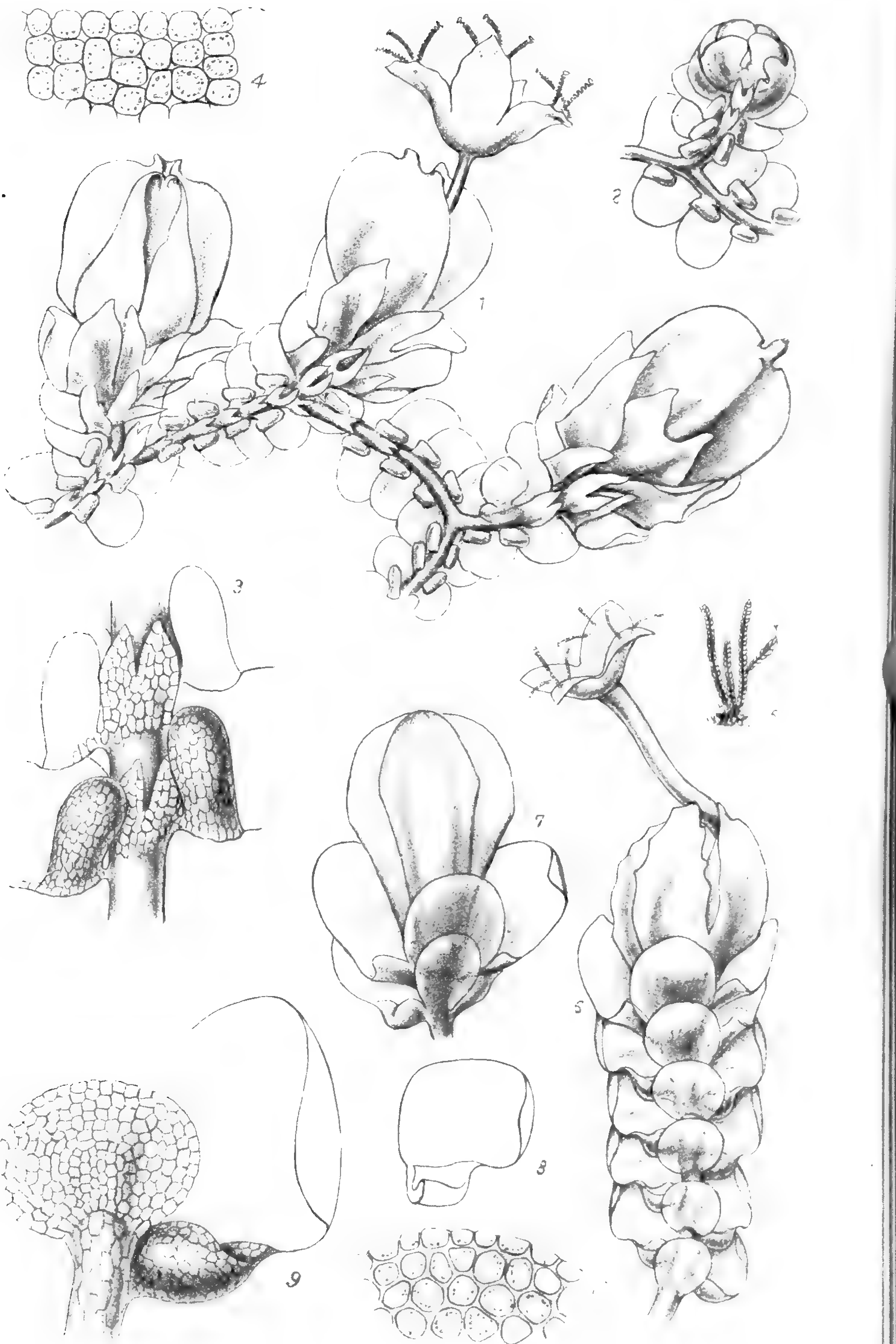
Fig. 1. *Frullania spatuliflora*, Spruce. Portion of stem, with three perianths and capsule, ×27.
2. Portion of stem with male spike, ×27.
3. Lobules and underleaves, ×95.
4. Marginal cells of leaf, ×280.
5. *Lejeunea* (§ *Acrolejeunea*) *atroviridis*, Spruce. Portion of plant, natural size.
6. Portion of stem with perianth and capsule, ×27.
7. Perianth, ×27.
8. Leaf, ×27.
9. Lobule and underleaf, ×95.
10. Marginal cells of leaf, ×280.

PLATE XXI.

Fig. 1. *Lejeunea* (§ *Prionolejeunea*) *vulcanica*, Spruce. Portion of plant with perianth and male spikes, ×27.
2. Lobules and underleaf, ×95.
3. Apical cells of leaf, ×280.
4. *Lejeunea* (§ *Prionolejeunea*) *guadalupensis*, Gottsche. Portion of stem with perianth and male spike, ×27.
5. Apical cells of leaf, ×280.
6, 7. *Lejeunea* (§ *Ceratolejeunea*) *brevinervis*, Spruce. Portions of stem with perianths, ×27.
8. Lobules and underleaf, ×95.
9. Cells from middle of leaf, ×280.

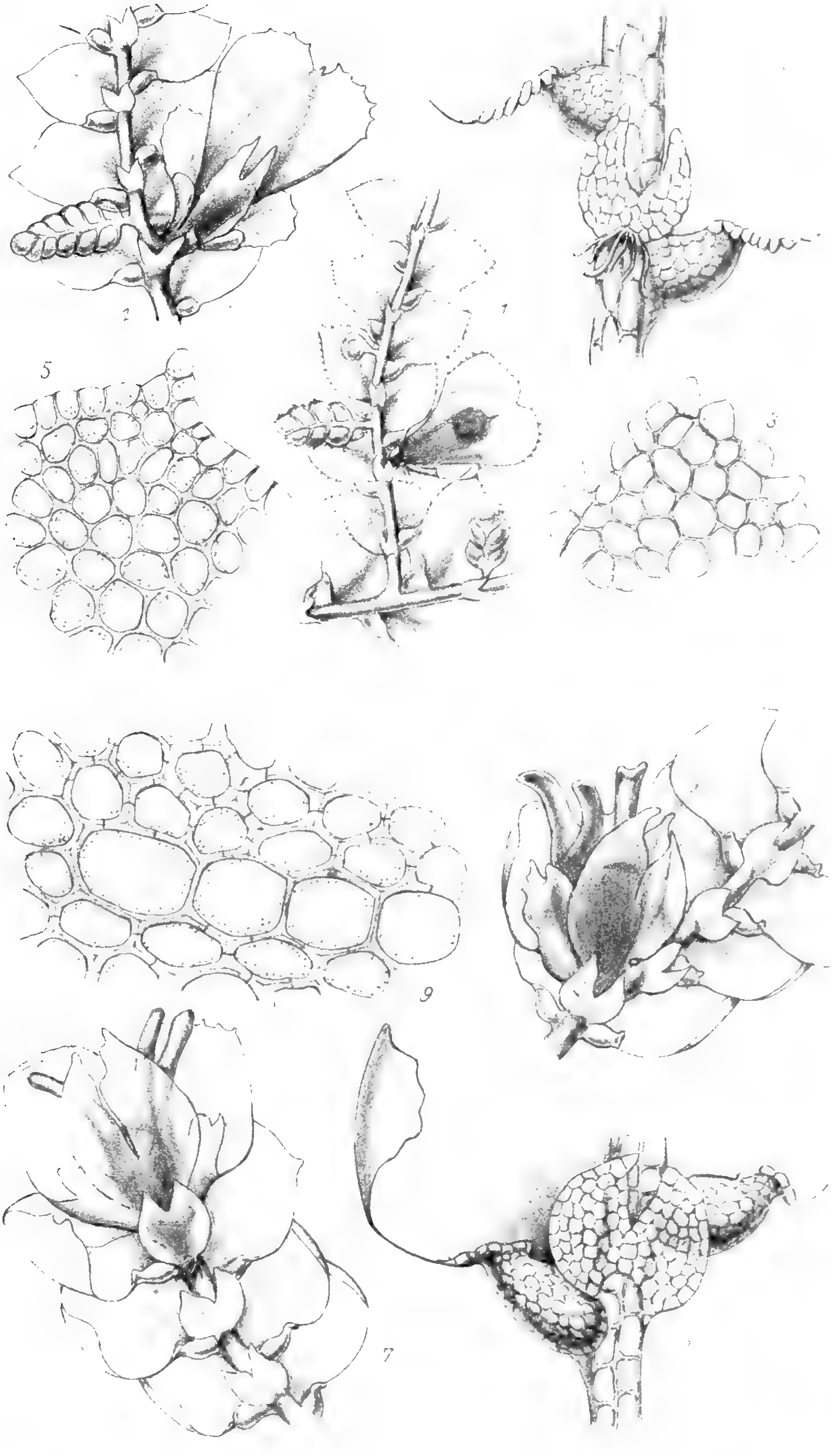
PLATE XXII.

Fig. 1. *Lejeunea* (§ *Taxilejeunea*) *graminicolor*, Spruce. Portion of stem with perianth and male spikes, ×27.
2. Lobules and underleaf, ×95.
3. Apical cells of leaf, ×280.



1-4. FRULLANIA SPATULIFLORA, *Spruce*
5-10. LEJEUNEA ATROVIRIDIS, *Spruce*.

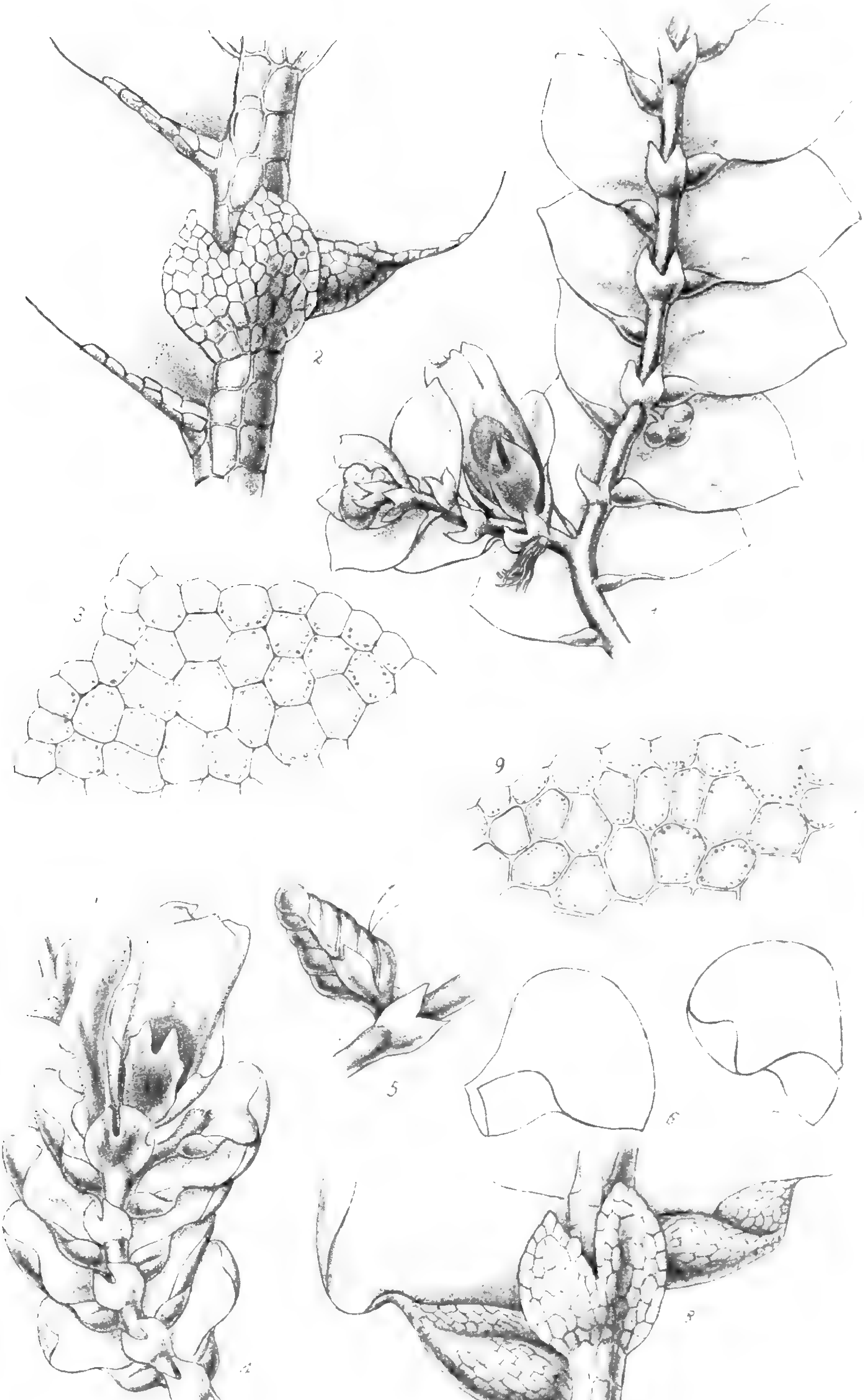
Spruce



Highley del. et lith.

[illegible] imp.

1-3 LEJEUNEA VULCANICA, *Spruce*
4-5 L. GUADALUPENSIS, *Gottsche*
6-9 L. BREVINERVIS, *Spruce*



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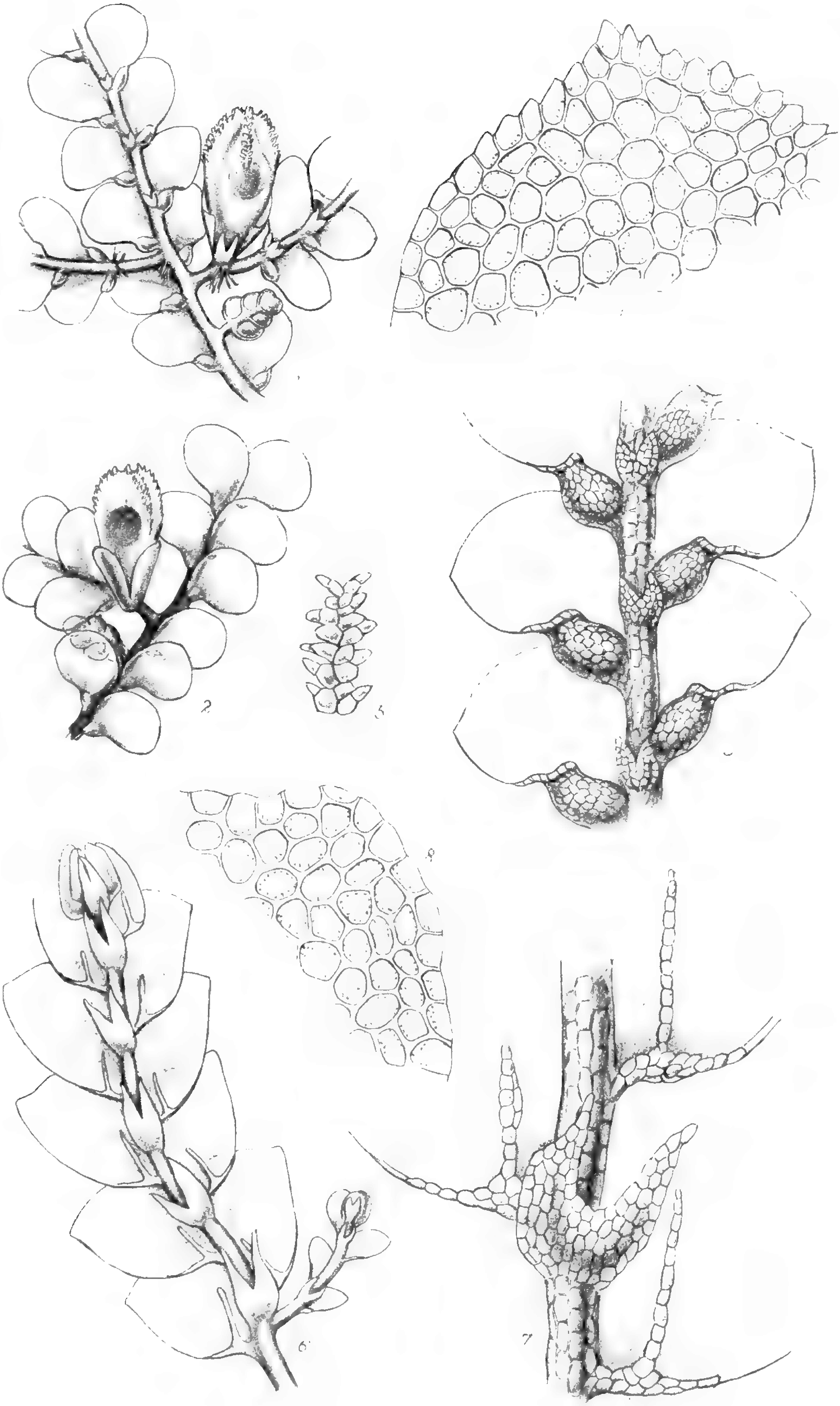
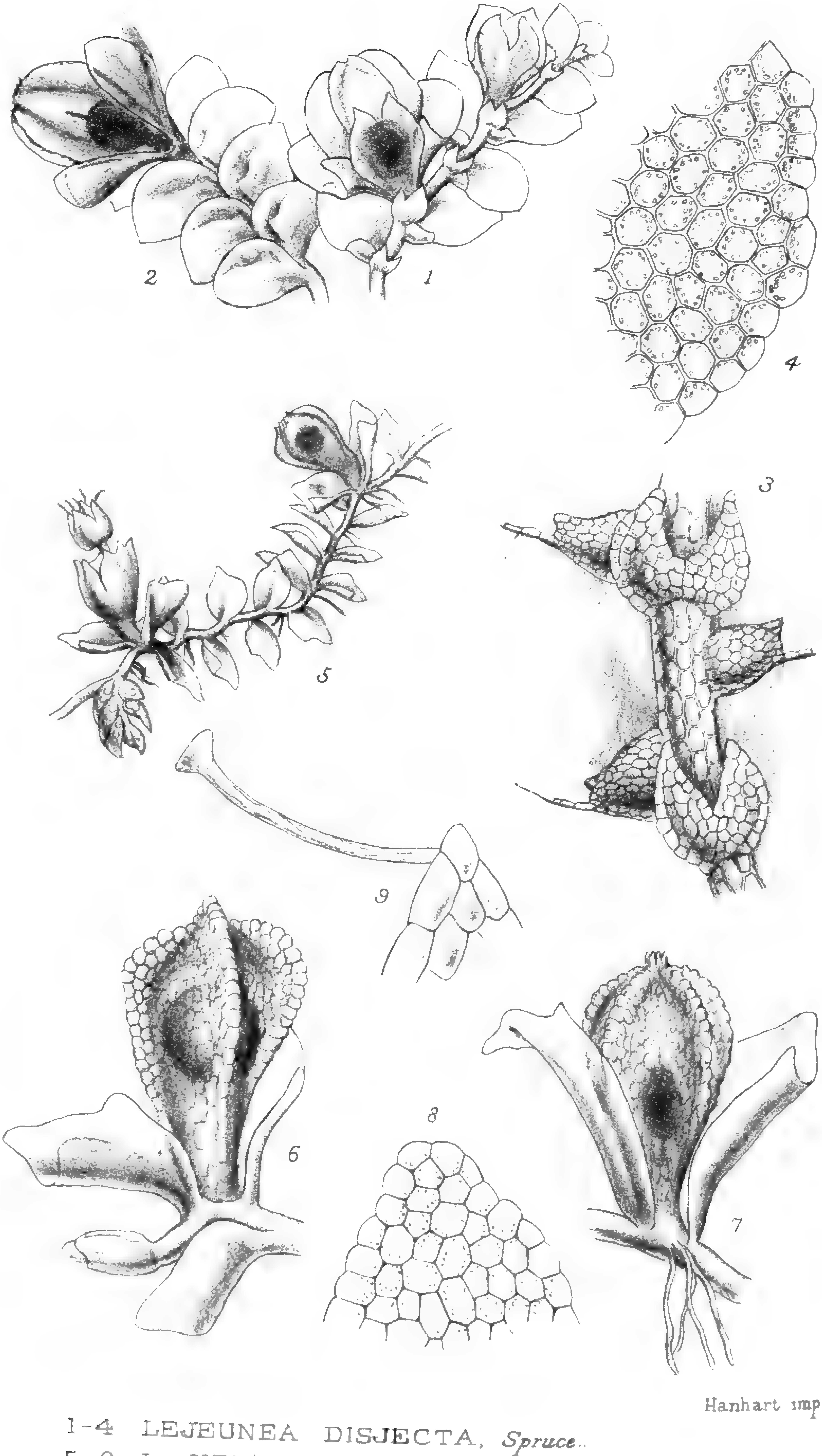
1-3 LEJEUNEA GRAMINICOLOR, *Spruce*
4-9 L. CORYNANTHA. *Spruce*.

Spruce



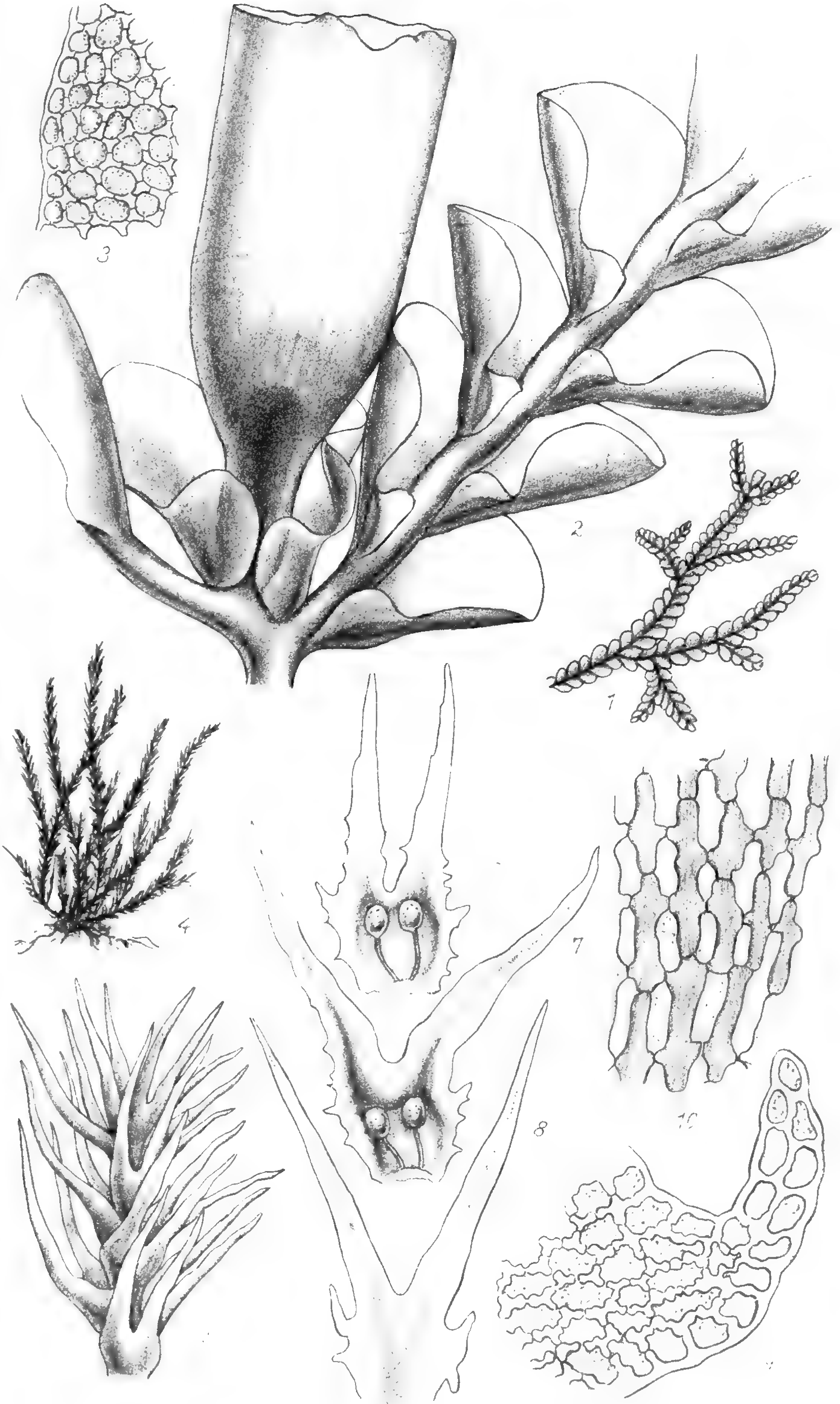
Hanhart imp.

1-5 LEJEUNEA ELLIOTTII, *Spruce.*
6-8 L. PILILOBA *Spruce.*



ley del et lith.
Hanhart imp.

1-4 LEJEUNEA DISJECTA, *Spruce.*
5-9 L. HETEROMORPHA, *Spruce.*



Highley del et lith

Hanhart imp.

1–3. RADULA SUBSIMPLEX, *Steph.*
4–10. SENDTNERA ELLIOTTII, *Spruce.*

Fig. 4. *Lejeunea* (§ *Hygrolejeunea*) *corynantha*, Spruce. Portion of stem with perianth, ×27.
5. Male spike, ×27.
6, 7. Leaves, ×27.
8. Lobules and underleaf, ×95.
9. Marginal cells of leaf, ×280.

PLATE XXIII.

Fig. 1. *Lejeunea* (§ *Eulejeunea*) *Elliottii*, Spruce. Part of plant (from below) with perianth and male spike, ×27.
2. The same (from above), ×27.
3. Lobules and underleaves, ×95.
4. Apical cells of leaf, ×280.
5. Unicellular papillæ on keel of perianth, ×280.
6. *Lejeunea* (§ *Eulejeunea*) *piliIoba*, Spruce. Part of plant, ×27.
7. Lobules and underleaf, ×95.
8. Marginal cells of leaf, ×280.

PLATE XXIV.

Figs. 1, 2. *Lejeunea* (§ *Eulejeunea*) *disjecta*, Spruce. Parts of plant from below and above, with perianths, ×27.
Fig. 3. Lobules and underleaves, ×95.
4. Marginal cells of leaf, ×280.
5. *Lejeunea* (§ *Cololejeunea*) *heteromorpha*, Spruce. Part of plant with perianths, capsule, and male spike, ×27.
6, 7. Perianths (from above and below), ×95.
8. Apical cells of leaf, ×280.
9. Elater and apex of capsular valve, ×280.

PLATE XXV.

Fig. 1. *Radula subsimplex*, Steph. Part of plant, natural size.
2. Part of plant with perianth, ×27.
3. Marginal cells of leaf, ×280.
4. *Sendtnera Elliottii*, Spruce. Plant, natural size.
5. Part of plant, ×15.
6, 7. Diandrous bracts, ×27.
8. Leaf, ×27.
9. Marginal cells of leaf, ×280.
10. Cells of vitta, ×280.

PLATE XXVI.

Fig. 1. *Cephalozia Wrightii*, Gottsche, var. *bicornis*, Spruce. Part of plant with perianth, ×27.
2. Leaves (from the side), ×95.
3. Leaves (from below), ×95.
4. Marginal cells of leaf, ×280.

Figs. 5, 6. *Alobiella dominicensis*, Spruce. Parts of plant with young perianth, ×27.
Fig. 7. Perianth, bracts and archegonia, ×27.
8. Underside of stem, ×95.
9. Apical cells of leaf, ×280.

Plate XXVII.

Figs. 1, 2. *Micropterygium portoricense*, Steph. Parts of plant with perianths, ×15.
Fig. 3. Leaves and underleaves, ×95.
4. Marginal cells of leaf, ×280.
5. *Leioscyphus ovatus*, Spruce. Part of plant with male spike, ×15.
6. Perianth (from below), ×15.
7. Apex of perianth (from the side), ×15.
8. Underleaves, ×95.
9. Marginal cells of leaf, ×280.

Plate XXVIII.

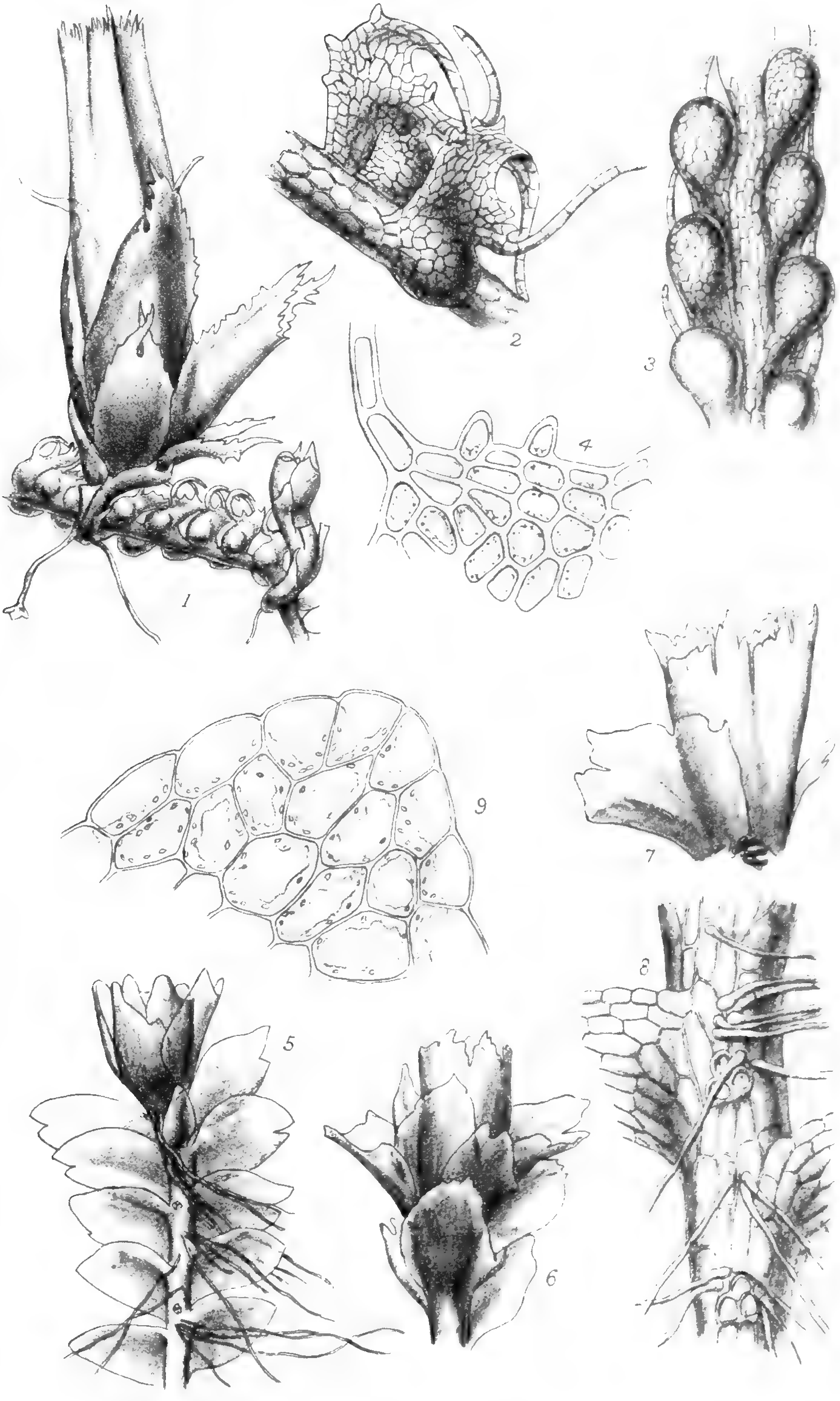
Fig. 1. *Plagiochila Elliottii*, Spruce. Part of plant, natural size.
2. Part of plant (from above), ×15.
3. Leaf, ×15.
4. Perianth, ×15.
5. Cells of leaf, ×280.
6. *Syzygiella perfoliata*, var. *lævigata*, Spruce. Plant, natural size.
7, 8. Parts of plant, ×27.
9. Marginal cells of leaf, ×280.

Plate XXIX.

Fig. 1. *Jungermannia dominicensis*, Spruce. Part of plant with perianths and male spike, ×27.
2. Part of stem, ×27.
3. Marginal cells of leaf, ×280.
4. *Jungermannia schistophila*, Spruce. Part of plant with perianths, ×27.
5. Male spike, ×27.
6. Apical cells of leaf, ×280.

Plate XXX.

Figs. 1, 2. *Scalia andina*, Spruce. Parts of plant (2, with perianths and capsule), natural size.
Fig. 3. Part of plant, ×5.
4. Valves of capsule, ×5.
5. Marginal cells of leaf, ×280.
6. Portions of elaters, ×280.
7. *Symphyogyna trivittata*, Spruce. Plant, natural size.
8. Part of plant showing male bracts, ×27.
9. Transverse section of stem, ×27.
10. Transverse section of vitta, ×280.
11. Marginal cells of thallus, ×280.



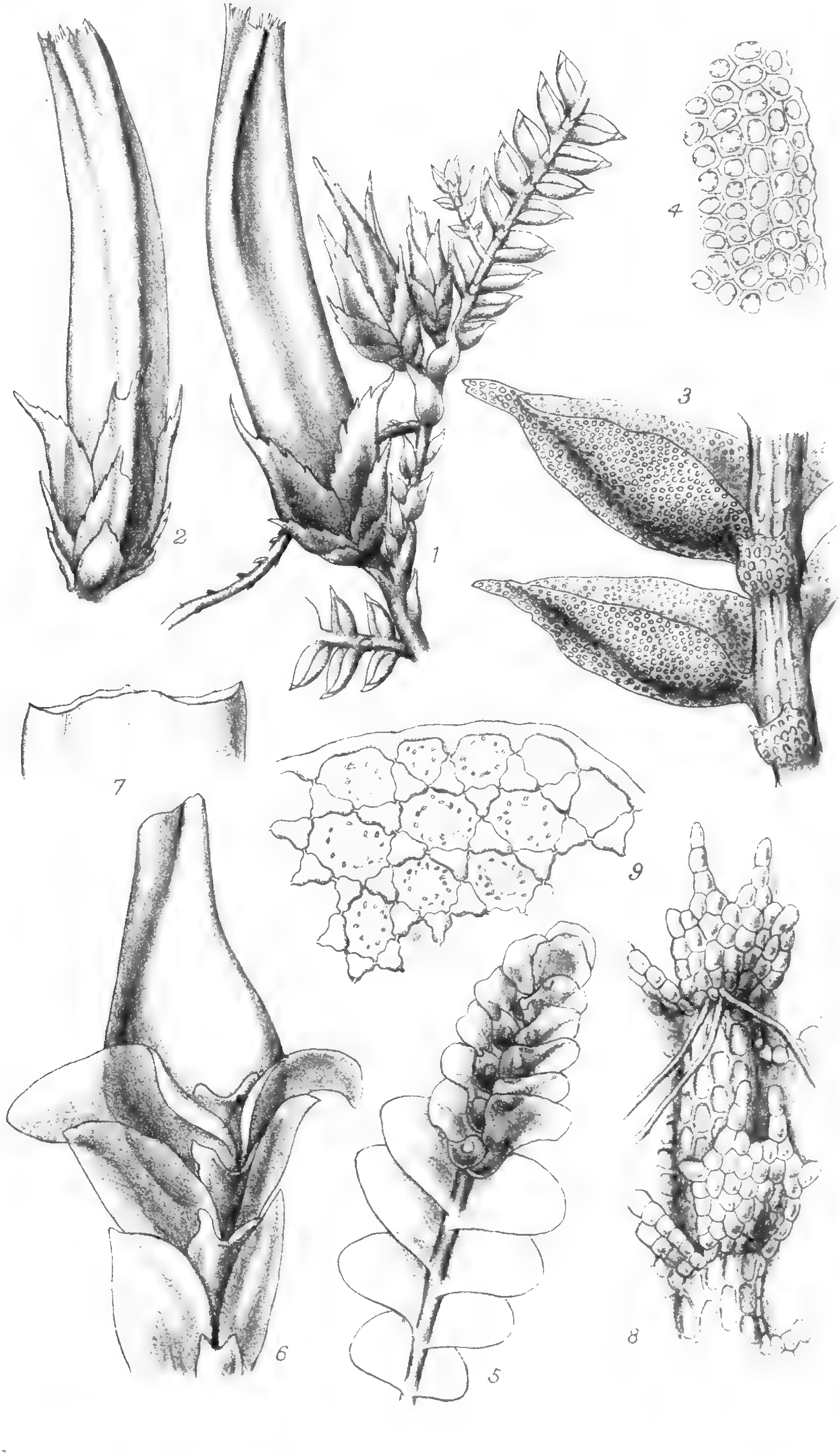
Highley del et lith

Hanhart imp

1-4. CEPHALOZIA WRIGHTII. *var bicornis*

5-9. ALOBIELLA DOMINICENSIS *Spr.*

27



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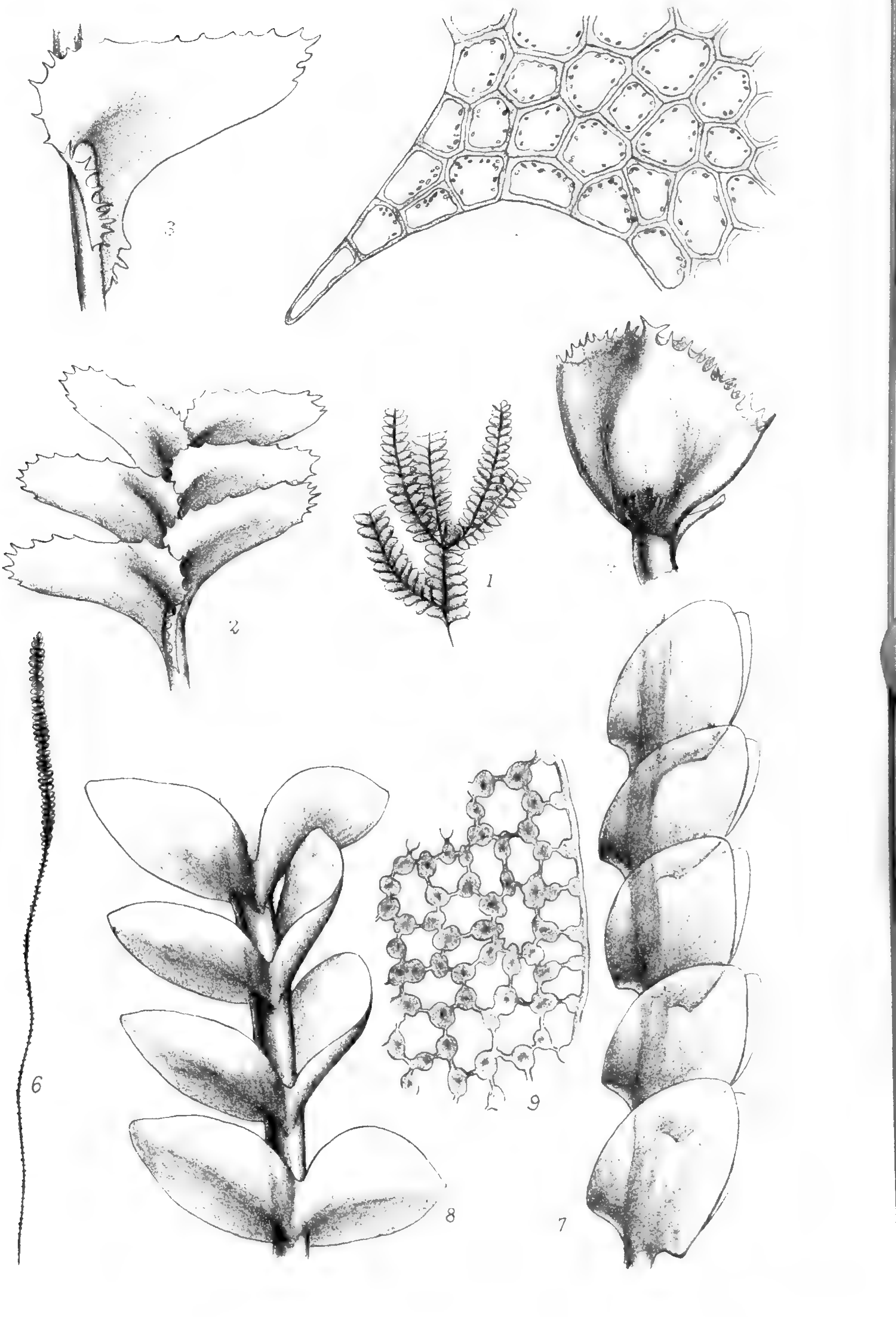
Hanhart imp.

1–4. MICROPTERYGIUM PORTORICENSE, *Steph.*
5–9. LEIOSCYPHUS OVATUS, *Spruce.*



Highley del et lith.

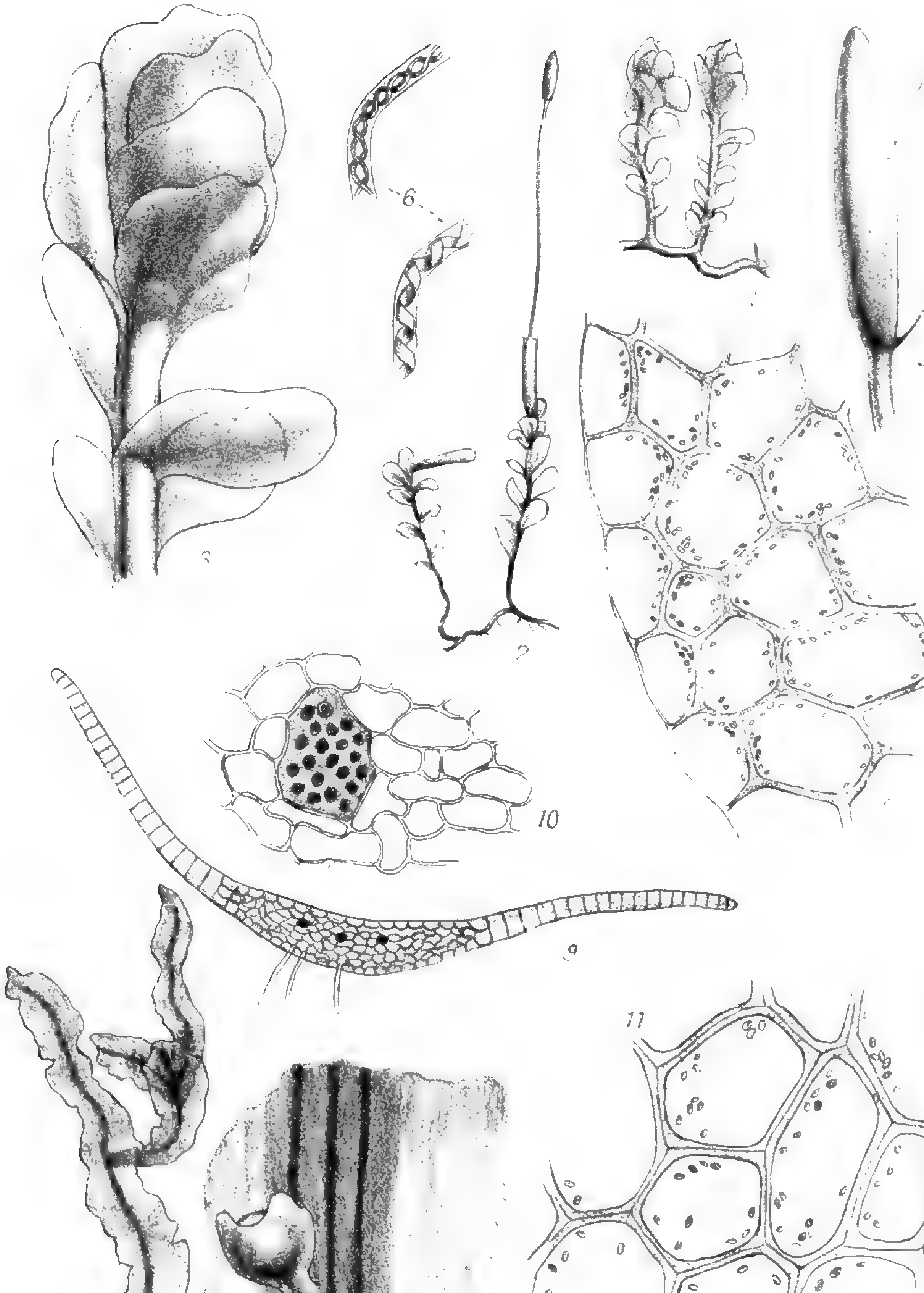
[illegible] imp.

1-5 PLAGIOCHILA ELLIOTTII [illegible]

6-9 SYZYGIELLA PERFOLIATA var. [illegible]

Highley del et lith
[illegible] imp

1-3 JUNGERMANNIA DOMINICENSIS, *Spruce*
4-6 J. SCHISTOPHILA, *Spruce*



Highley del et lith

1-6 SCALIA ANDINA, *Spruce*

7-11 SYMPHYOGYNA TRIVITTATA, *Spruce*

A Contribution to the Flora of Eastern Tropical Africa. By A. B. Rendle, M.A., B.Sc., F.L.S., Assistant in Botany, British Museum.

[Read 21st June, 1894.]

(Plates XXXI.-XXXIV.)

The present paper deals with the petaloid monocotyledons and plants of a few allied families recently collected in Eastern Equatorial Africa by the Rev. W. E. Taylor, of the Church Missionary Society, and Dr. J. W. Gregory, of the Geological Department of the British Museum, all of which will be found in the Herbarium of the latter institution. Of Mr. Taylor's plants a large proportion were collected near Mombasa, a few at Freretown and on the island itself, the rest on the Rabai Hills, a low range (up to 800 feet) near Mombasa, or on the Giryama and Shimba hills, south of that place. A considerable number were gathered either at Uyui, near Tabora in Unyamwezi country, or on the route thence to the coast opposite Zanzibar, and a few on Mt. Kilimanjaro at elevations ranging from 4000 to 10,000 feet. Dr. Gregory collected on Mt. Kenya up to the terminal moraine of sheet glaciation; on the Laikipia plateau, in the Kikuyu country south of Kenya; and along the valley in which lie lakes Naivasha and Baringo. Also on the Taita mts. to 4400 feet; on the East Ongalea mts. due east of Kilimanjaro and 150 miles from Mombasa, at an elevation of 2200 feet; at Kariandusi (6100 feet), at the south end of Lake Elmetaita in the Masai country; on the Athi plains; and at various places in the Tana river-basin. The plants collected between Unyamwezi and the coast are chiefly of tropical African affinity, serving in several instances to connect the Eastern and Western floras, or rather indicating the floral identity of these regions. For example, *Chlorophytum andongense* from Angola was found at Uyui, while two new Chlorophytums, a new *Anthericum*, and a new *Lapeyrousia* also find their nearest allies in plants collected by Welwitsch in Angola; a fourth *Chlorophytum* most nearly approaches one from the Cameroons. This means that nearly one-fifth of these plants are, in our present knowledge, of exclusively West-African affinity. *Cyanotis hirsuta* from Uyui is Abyssinian; a new *Eulophia* and a new *Urginea* are of the same affinity; a new *Albuca*, found also on the Rabai Hills, is allied to *A. Steudneri* from Kalabat; while a new *Habenaria* finds its nearest ally in the Kilimanjaro plant, *H. stylites*. A new *Polystachya* approaches the South-African *P. tessellata*.

Of thirty plants from the coast-ranges near Mombasa, ten have an exclusively east tropical African affinity; of these *Dioscorea triphylla* is Abyssinian; *Habenaria rabaiensis*, sp. n., is allied to *H. Volkensiana* from Kilimanjaro; *Anthericum giryamæ*, sp. n., to *A. milanjianum* from Mt. Milanji; while *Commelina Bainesii* var. *glabrata* is another high Nyasaland plant. Only one, *Angræcum semipedale*, sp. n., shows exclusively West-African affinity. Six are more or less general in Tropical Africa, three in Tropical and South Africa, two in these and Madagascar, while one, *Angræcum fimbriatum*, sp. n., is of South-African affinity. *Gladiolus Taylorianus*, sp. n., is allied to *G. Quartinianus*, a tropical African mountain plant. *Angræcum giryamæ*, a fine species, falls between the Malagasy *A. superbum* and the Bourbon *A. eburneum*; and *Pandanus rabaiensis* is also near *P. utilis* from Madagascar.

Eight of the fourteen species from Kilimanjaro are new, and include two Habenarias allied to Abyssinian species; a *Hesperantha* allied to *H. alpina* from the Cameroons; an *Aristea* closely connected with one from Mt. Milanji in Nyasaland; a *Romulea* near *R. gracillima* from the mountains of Namaqualand; and a *Disa* and *Disperis* allied to South-African species. Of the species hitherto described, *Dierama pendula* and *Asparagus plumosus* are South-African, but recently recorded from Mt. Milanji. Of the five Kenya plants one or two are new, namely, a *Disa* allied to *D. Welwitschii* from Angola, and perhaps a Podocarp near the West Tropical African *Podocarpus Mannii*. *Gladiolus watsonioides*, previously described from the higher slopes of Kilimanjaro, was found by Dr. Gregory at the terminal moraine of sheet glaciation; the Abyssinian variety *simensis* of the arctic and alpine *Luzula spicata*, in the bamboo zone; and, lower still, in the lower forest zone, the temperate *Juncus effusus*. From the Laikipia plateau come the north temperate and alpine *Alisma Plantago* and a new *Hypoxis* allied to the Angolan *H. polystachya*.

A *Peristylus* from Kariandusi very closely resembles a new one collected by Buchanan in Nyasaland.

The detailed lists which follow will serve to show the affinity and distribution of the species from the various localities.

Between Zanzibar and Uyui or Unyamwezi.

Lagarosiphon crispus, sp. n.: near *L. tenuis*, sp. n., East Ongalea mts., and *L. Nyassæ*, Ridl., Nyasaland.

Eulophia longepedunculata, sp. n.: near *E. Petersii*, Reichb. f., Zanzibar, and *E. Schimperi*, Hochst., Abyssinia.

Lissochilus Taylorii, Ridl.

Polystachya Tayloriana, sp. n.: near *P. tessellata*, Lindl., S. Africa.

Habenaria tenuicaulis, sp. n.: near *H. Buchananiana*, Kraenz., Nyasaland.

H. æquatorialis, sp. n.: near *H. stylites*, Reichb. f. & S. Moore, Kilimanjaro.

Lapeyrousia congesta, sp. n.: near *L. odoratissima*, Baker, Huilla, Angola.

Gladiolus, sp.; *G. corneo*, Oliver, aff. Mts. east of L. Tanganyika.

Hypoxis villosa, L. S. Africa to Abyssinia.

Vellosia æquatorialis, sp. n.: near *V. tomentosa*, Pax, East Equatorial Africa.

Anthericum acuminatum, sp. n.; also Taita mts.: near *A. Grantii*, Baker, same district.

A. uyuiense, sp. n.: near *A. Grantii*, Baker, same district.

A. Taylorianum, sp. n., Uyui: near *Chlorophytum affine*, Baker, same district.

A. speciosum, sp. n., Uyui: near *A. pterocaulon*, Welw., Angola.

Chlorophytum andongense, Baker, Uyui. Angola.

C. miserum, sp. n.: affinity Tropical-African.

C. moniliforme, sp. n., Uyui.

C. fusiforme, sp. n.: near last named.

C. ramiferum, sp. n.: near *C. petiolatum*, Baker, Cameroons.

C. marginatum, sp. n., Uyui: near *C. falcatum*, Huilla.

C. papillosum, sp. n.: near *C. colubrinum*, Angola.

Urginea Tayloriana, sp. n.: near *U. Petitiana*, Solms, Abyssinia.

Albuca Tayloriana, sp. n., also Rabai Hills: near *A. Steudneri*, Schw. & Engl., Kalabat.

Scilla textilis, sp. n., Uyui: near *S. lanceæfolia*, Baker, S. and Tropical Africa.

Scilla uyuiensis, sp. n., Uyui: near *S. somaliensis*, Baker, Somaliland.

Gloriosa virescens, var. *latifolia*, n. var. Type in Tropical and S. Africa.

Walleria Mackenzii, J. Kirk. Tropical Africa.

W. nutans, J. Kirk, Uyui. East Tropical Africa.

Cyanotis hirsuta, Fisch. et Mey., Uyui. Abyssinia.

Kilimanjaro.

Habenaria altior, sp. n., higher slopes: near *H. Schimperiana*, Rchb. f., Abyssinia.

H. splendens, sp. n., higher slopes: near *H. macrantha*, Hochst., Abyssinia.

Disa kilimanjarica, sp. n., higher slopes: near *D. polygonoides*, Lindl., S. Africa.

Disperis alpina, sp. n., higher slopes: near *D. Macowani*, Bolus, S. Africa.

Romulea alpina, sp. n., higher slopes: near *R. gracillima*, Baker, mts. of Namaqualand.

Aristea Tayloriana, Rendle, higher slopes: near *A. Johnstoniana*, Rendle, Mt. Milanji, Nyasaland.

Hesperantha kilimanjarica, sp. n., higher slopes: near *H. alpina*, Cameroons.

Dierama pendula, Baker, sp. n., higher slopes. S. Africa to Natal and Mt. Milanji.

Gladiolus splendidus, sp. n., higher slopes: near *G. kilimandscharicus*, Pax, Kilimanjaro.

G. sp.; *G. Quartiniano*, A. Rich., aff.: Mochi, 4000–5500 ft. Mts. of Tropical Africa.

Asparagus plumosus, Baker, Morang, 5000–6500 ft. S. Africa to Mt. Milanji.

Kniphofia Thomsoni, Baker, Morang and higher slopes. Kilimanjaro.

Aneilema æquinoctiale, Kunth, Mochi, 4000–5500 ft. Tropical Africa and Arabia.

Lissochilus arenarius, Lindl., Morang, 5000–6500 ft. Tropical Africa.

Rabai Hills (R.) and Giryama and Shimba Hills (G. S.).

Lissochilus arenarius, Lindl. (R.). Tropical Africa; also Kilimanjaro.

L. Wakefieldi, Reichb. f. & S. Moore (R.). East Tropical Africa.

Polystachya Kilimanjari, Reichb. f. (R.). East Tropical Africa.

Angræcum arcuatum, Lindl. (G. S.). South and Tropical Africa.

A. bilobum var. *Kirkei*, Reichb. f. (R.). East Tropical Africa.

A. fimbriatum, sp. n. (G. S.): near *A. bicaudatum*, Lindl., South Africa.

A. giryamæ, sp. n. (G. S.): near *A. eburneum*, Thou., Bourbon, and *A. superbum*, Thou., Madagascar.

A. semipedale, sp. n. (R.): near *A. apiculatum*, Hook., West Tropical Africa, and *A. avicularium*, Reichb. f., Tropical Africa.

Vanilla Humblotii, Reichb. f. (G. S.). Comoro Is.

Habenaria rabaiensis, sp. n. (R.): near *H. Volkensiana*, Kraenz., Kilimanjaro.

Sansevieria cylindrica, Bojer (R.). Tropical Africa.

S. sp.; *S. guineensi*, Willd., aff. (R.). Tropical Africa.

Gladiolus Taylorianus, sp. n. (R.).: near *G. Quartinianus*, A. Rich., mts. of Tropical Africa.

Hypoxis angustifolia, Lam. (R.). Trop. to S. Africa; Madagascar and Mascarenes.

Hæmanthus multiflorus, Martyn (R.). Tropical Africa.

Dioscorea triphylla, Schimp. (R.). Abyssinia.

Asparagus æthiopicus, Linn. (R.). Tropical and S. Africa and Madagascar.

A. africanus, Lam. (R.). Tropical and S. Africa.

A. racemosus, Willd. (R.). Tropical and subtropical parts of Old World.

Aloe rabaiensis, sp. n.: near *A. venenosa*, Engl., East Tropical Africa.

Anthericum Giryamæ, sp. n. (G. S.): near *A. milanjianum*, Rendle, Mt. Milanji, Nyasaland.

Albuca Tayloriana, sp. n. (R.): near *A. Steudneri*, Schweinf. & Engl., Kalabat.

Scilla Tayloriana, sp. n. (R.): near *A. lilacina*, Baker, Nubia.

Gloriosa virescens, Lindl. (R.). Tropical and S. Africa.

Commelina Bainesii, var. *glabrata*, Rendle (R.). Zomba, Nyasaland.

Aneilema æquinoctiale, Kunth (R.), also Kilimanjaro. Tropical Africa and Arabia.

A. sinicum, Lindl. (R.). Tropical and S. Africa, and Tropical Asia to China.

Cyanotis lanata, Benth. (G. S.). Tropical Africa.

Flagellaria indica, Linn. (R.). Warmer parts of Old World.

Pandanus rabaiensis, sp. n. (R.): near *P. utilis*, Bory, Madagascar.

Mombasa Island.

Acampe mombasensis, sp. n.: near *A. pachyglossa*, Reichb. f., mainland near Mombasa.

Angræcum arcuatum, Lindl.; also Giryama and Shimba mts. S. and Tropical Africa.

Chlorophytum Heynei, Baker. E. India.

Freretown.

Angræcum bilobum, var. *Kirkei*, Reichb. f.; also Rabai Hills. E. Tropical Africa.

Commelina albescens, Hassk. Tropical Africa to India.

C. Forskalæi, Vahl, aff. Tropical Africa, Arabia, and India.

Athi Plains.

Acidanthera candida, sp. n.: near *A. laxiflora*, Baker, Kilimanjaro, 2000 ft.

East Ongalea Mountains.

Lagarosiphon tenuis, sp. n., Kinani, 2200 ft.: near *L. Nyassæ*, Ridley, Nyasaland.

Commelina subulata, Roth, Kinani, 2200 ft. Tropical Africa and India.

Naias graminea, Del., Kinani, 2200 ft. Tropical Asia to Egypt.

Taita Mountains.

Habenaria ndiana, sp. n., Ndi, 4000 ft.: near *H. incarnata*, Lindl., Madagascar; and *H. humilior*, Reichb. f., and *H. pedicellaris*, Reichb. f., Abyssinia.

Anthericum acuminatum, sp. n., Kifaniko. Affinity East Tropical African.

Kariandusi.

Lagarosiphon hydrilloides, sp. n., 6100 ft.

Peristylus hispidula, var. *minor*, var. nov., N.E. of Kariandusi, 6100 ft. The species in Nyasaland.

Gladiolus, sp.; *G. Quartiniano*, A. Rich., aff.: 6100 ft. Mts. of Tropical Africa.

Laikipia Plateau.

Gladiolus, sp.; *G. Quartiniano*, A. Rich., aff. Mts. of Tropical Africa.

Hypoxis laikipiensis, sp. n.: near *H. polystachya*, Welw., Huilla, Angola.

Gloriosa virescens, Lindl. Tropical and S. Africa.

Commelina africana, Linn., foot-hills. Tropical and S. Africa; Bourbon.

Alisma Plantago, Linn. North temperate and alpine.

Kenya.

Disa Gregoriana, sp. n., terminal moraine of sheet glaciation: near *D. Welwitschii*, Reichb. f., Angola.

Gladiolus watsonioides, Baker, terminal moraine. Higher slopes of Mt. Kilimanjaro.

Juncus effusus, L., lower forest-zone. Temperate.

Luzula spicata, var. *simensis*, Hochst., lower edge of bamboo-zone. Abyssinia.

Podocarpus, *P. Mannii*, Hook. f., aff., bamboo-zone. S. Thomé.

South of Kenya.

Habenaria pedicellaris, Reichb. f., steppes of Thika-Thika, South of Kenya. Abyssinia.

Ornithogalum Eckloni, Schlecht., Kikuyu Country, S. of Kenya. S. and Tropical Africa.

Commelina purpurea, C. B. Clarke, steppes between Ndoro and Guaso Thegu, S.W. of Kenya.

Juncus Fontanesii, J. Gay, steppes between Ndoro and Guaso Thegu, S.W. of Kenya. Mediterranean, Orient, and Abyssinia.

Aponogeton abyssinicum, sp. n., Kikuyu. Tropical Africa.

Naivasha and Baringo Valley.

Hypoxis Gregoriana, sp. n., Kikuyu escarpment, Kedong River S. of L. Naivasha: near *H. laikipiensis*, mihi.

Crinum, sp.

Asparagus plumosus, Baker, Kikuyu escarpment. S. Africa to Mt. Milanji.

A. medeoloides, Thunb., Kikuyu escarpment. S. Africa.

Bulbine asphodeloides, Schult. f., Kikuyu escarpment. S. and Tropical Africa.

Typha angustifolia, Linn., east side of Lake Losuguta. Temperate and warmer parts of northern hemisphere.

HYDROCHARIDEÆ.

LAGAROSIPHON TENUIS, sp. nov. (Pl. XXXI. figs. 1–7.) Planta tenuis bryoides; foliis confertis linearibus, a basi sensim angustatis, apice obtusiusculis, margine a dentibus validis ascendentibus instructis, stipulis minutis subulatis; floribus fœmineis axillaribus; spatha oblonga, apice bifida edentata vel dentibus perpaucis munita; perianthii tubo vix unciali, segmentis oblongis semilinearibus; ovario elongato-pyriformi.

Hab. Kinani, East Ongalea Mountains, 2200 ft.: J. W. Gregory, 1893.

A slender delicate plant, recalling *L. Nyassæ*, Ridl., in habit. The crowded leaves are 4–5 lines long, $\frac{1}{4}$–$\frac{1}{3}$ line broad at the base, tapering gradually to the subobtuse apex, with about 30 upwardly directed teeth on each side. The teeth are situated on small few-celled elevations of the leaf-margin; the normal leaf-cells extend to beneath the epidermis, there being no distinctive hypodermal layers as in *L. Schweinfurthii* and others. Only female flowers were present, situated in the axils of ordinary leaves. The oblong spathe is 1 line long and bifid for $\frac{1}{3}$ its length from the apex; generally entire, though sometimes with a few scattered teeth. The perianth-tube is about $\frac{3}{4}$ in. long, the expanded flower 1 line in diameter, the individual oblong petals $\frac{1}{2}$ line long.

Resembles *L. Nyassæ*, Ridl., but the female flowers are much longer, with oblong, not lanceolate petals, while the leaf-teeth are emergences, not simple outgrowths of the epidermis as in that species. *L. Schweinfurthii*, Casp., has larger, more densely toothed leaves with obovate obtuse stipules.

Lagarosiphon crispus, sp. nov. (Pl. XXXI. figs. 8–17.) Herba subvalida; foliis linearibus densis interdum suboppositis, crispis, plus minusve reflexis, in caulibus semipollicaribus et acutis, in ramulis autem minoribus et obtusis, exstipulatis, margine utroque a dentibus pluribus (ad quadraginta), compositis spinosis instructis, costa media venulisque brevibus transversis valde conspicuis; spatha ♀ 1-flora ampullæformi, integra, apice proventu bifida, 1-lineari, perianthii segmentis oblongis; spatha ♂ multiflora cyathiformi, margine bilabiata sparse spinulosa; antherarum loculis binis pendentibus; fructu bruneo, sesquilineari, fusiformi, rostrato.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

A small plant with stiffish stems $\frac{2}{3}$ line in diameter, densely covered with crisp more or less reflexed linear leaves, sometimes subopposite, 6–7 lines long by $\frac{1}{2}$ line broad, with about 40 sharp outwardly and upwardly directed teeth seated on a triangular base of several cells; on the branches the leaves are smaller (5 lines × $\frac{1}{3}$ line), with rather fewer teeth (about 35) and a blunter tip; the conspicuous midrib is united by transverse veinlets to two parallel but weaker longitudinal veins, and the rectangular areas thus formed are filled with cells longer and poorer in chlorophyll than those forming the rest of the mesophyll. Intrafoliar stipules are absent, but the somewhat enlarged leaf-base bears a pair of teeth on either side. The male inflorescences are sessile in the leaf-axils on the main shoots, the cup-like spathes, about $\frac{1}{2}$ line long, containing several flower-buds; the three short stamens bear two pendent anther-cells, each with a pointed tip. The female flowers are borne on the ultimate branches, the single-flowered axillary flask-shaped spathes being 1 line in length and without teeth; the perianth-tube is $\frac{3}{4}$ in. long, the colourless oblong segments about $\frac{1}{3}$ line, the papillose stigmas are also $\frac{1}{3}$ line in length. The brown broadly spindle-shaped fruits are $1\frac{1}{2}$ line long, or about 2 lines including the beak.

Resembles *L. tenuis*, mihi, in the characters of the female spathe and flower, but differs in having larger, linear, crisp reflexed leaves with more depressed teeth.

Lagarosiphon hydrilloides, sp. nov. (Pl. XXXII. figs. 1–7.) Planta subrobusta; foliis saturate viridibus, verticillatis vix pollicaribus, linearibus, apice rotundatis, costa media subconspicua et hypodermate pallido lineatis, margine utroque a dentibus plurimis ad centum simplicibus spinulosis instructis; stipulis intrafoliariis triangulari-subulatis; spatha ♂ . . . .; spatha ♀ biflora (?), oblonga, apice bifida, marginibus suturisque spinulosis; perianthii segmentis oblongis; ovario multiovulato, ovulis erectis, funiculis longis, stigmatibus tribus bifidis.

Hab. Kariandusi, 6100 ft.: J. W. Gregory, May 8th, 1893.

The subrobust stems are nearly 1 line in diameter and bear the leaves in whorls of 3–5, the lower internodes being about ⅜ in. long, but becoming much shorter above, the upper part of the shoot being densely leafy. The leaves are about 10 lines long, scarcely 1 line broad at the base, whence they taper slightly to the rounded tip; each margin bears about 100 rather close-set spiny tooth-cells projecting upwards from the small-celled epidermis, beneath which is a hypoderma consisting of two rows of narrow elongated, almost colourless, regular cells; there is a pair of delicate colourless triangular-subulate intrafoliar stipules, each half a line long. No male flowers were present. The female spathes are large, being 2½ lines long by ½ line broad, bifid for nearly ⅓ their length, and minutely spinulose on the free margins, with a few pairs of small spiny teeth on the lateral sutures. Each spathe bears a developed flower, and also encloses at the base an unopened female bud, so that it is potentially 2-flowered. The pyriform unicellular ovary contains 5 long-stalked orthotropous ovules.

Resembles in appearance the common *Hydrilla verticillata*, Presl, owing to the whorled leaf-arrangement, in which it differs from all other species of *Lagarosiphon*, though a tendency to this arrangement is observed in *L. rubella*, Ridl.

In the bifid stigmas and erect ovules it conforms to *Lagarosiphon*, these being respectively entire and anatropous in *Hydrilla*. In both genera the female spathes are described as one-flowered, but in the present species a small unopened bud is found by the side of the ovary of the developed flower.

ORCHIDEÆ.

EULOPHIA LONGEPEDUNCULATA, sp. nov. Planta egregia, glabra; rhizomate repente squamato, a radicibus cylindricis longis suffulto; caule foliato pseudobulboso, a vaginis longis subscariosis acuminatis circumdato; foliis pedalibus vel ultra, rigidis, plicatis, carinatis, falcatis, linearibus apicem versus angustatis, facie striatis rugulosisque, margine scabridis; pedunculo albescente 5-pedali, striato basi arcte vaginato; bracteis inferioribus distantibus subscariosis, pallidis acuminatis pedunculum arcte amplectantibus, superioribus fulvis patentibus, racemi autem laxiflori minoribus subulatis, superne deminutis; floribus inter majores, pedicellis bracteas superantibus; sepalis ligulatis vix uncialibus, 5-nerviis, quam petala oblongo-ligulata longioribus; labello subpollicari parte inferiore oblongo quam pars superior duplo longiore, hac autem subquadrata apiculata, basi angustiore cum callis lamelliformibus in venis insitis; calcari brevi, obtuso, recurvato.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1887.

A fine plant with a creeping rhizome $\frac{1}{4}$–$\frac{1}{3}$ in. thick, bearing scarious imbricating scales and long colourless air-roots, the latter a foot long by 2 lines in diameter. The pseudobulbous stem, borne 1 inch behind the peduncle, is 3 inches in length, and surrounded by large colourless acuminate sheathing leaves, the longest 5 inches; it bears three terminal curved falcate rigid leaves, 12–16 inches long, and 7 lines broad, but tapering above, with a keeled midrib and four lateral veins prominent on the striate lower surface and the margin markedly scabrid. The light-coloured terete peduncle is 5 feet long and $2\frac{1}{2}$ lines in diameter below, sheathed at the base and bearing on the lower half a few distant bracts with well-marked ribs converging to the acuminate apex, and margins united in the lower half, free and receding above but closely applied to the stalk; the lowest is $1\frac{3}{4}$ inch long, the upper ones becoming shorter; on the upper half the bracts are narrowly triangular acuminate, spreading from the base, and light brown in colour with five darker veins, becoming narrower, shorter, and more subulate in the flowering portion, and gradually decreasing to the end of the peduncle; the flowers, about 16 in number, are scattered in a lax raceme a foot long, the stalk and ovary much exceed the bract, being $1\frac{1}{2}$ inch long in the lower flowers. The ligulate sepals are 5-nerved with a subaristate falcate apex, 11 lines long and 2 lines broad, the oblong-ligulate apiculate petals are 9 lines long by $2\frac{3}{4}$ broad, with three nerves running the whole length and 2 outer ones about $\frac{3}{4}$ the length. The spreading lip is $11\frac{1}{2}$ lines long, with a short, strongly recurved spur $3\frac{1}{2}$–4 lines long, in the lower two-thirds it is oblong, $4\frac{3}{4}$ lines at its broadest, with several (5, including the thinner median one) prominent longitudinal veins, the outer ones on each side sending ramifying branches towards the margin; the terminal portion is 4 lines long and 3¼ broad in its broadening upper part; it bears on the disc a number of thin lamelliform subfleshy calli. The column is 5½ lines long. The slender subcylindrical fruit is 1½ inch long.

Is near *Eulophia Petersii*, Reichb. f., from Zanzibar, but is a much larger plant with larger flowers and the sepals and petals narrower in proportion to their length.

Is also near the Abyssinian *E. Schimperi*, Hochst., which has, however, a branched inflorescence with small triangular bracts, while the flower in our species is larger, and the calli on the lip more striking and much larger.

EULOPHIA PETERSII, *Reichb. f. in Flora*, xlviii. p. 186.

A plant collected by Taylor "between Zanzibar and Uyui" closely resembles this species, collected by Hildebrandt near the town of Zanzibar (no. 1043), but is somewhat larger, with slightly larger flowers and longer floral bracts.

LISSOCHILUS ARENARIUS, *Lindl. in Journ. Linn. Soc., Bot.* vi. p. 133.

Rabai Hills, March 1886, and Mt. Kilimanjaro at Morang, 5000 to 6500 feet, 1888: W. E. Taylor.

Distrib. Tropical Africa.

A plant collected at Uyui, also by Taylor, differs from the common form in its somewhat smaller flowers with a shorter and much narrower terminal lobe to the labellum, resembling in this respect the smaller plants from Natal, which have been called *L. arenarius*, but may perhaps be distinct.

LISSOCHILUS TAYLORII, *Ridl., in Journ. Bot.* 1886, p. 293.

Between Zanzibar and Uyui: W. E. Taylor, 1886.

LISSOCHILUS WAKEFIELDI, *Reichb. f. et S. Moore in Journ. Bot.* 1878, p. 136.

Rabai Hills: W. E. Taylor, Sept. 1885 and Jan. 1886.

POLYSTACHYA KILIMANJARI, *Reichb. f. in Trans. Linn. Soc.* ser. 2, *Bot.* ii. p. 346.

Rabai Hills: W. E. Taylor, March 1886.

The plant on which Reichenbach founded the species was gathered by H. H. Johnston, *40–60 miles from the coast*, on the Kilimanjaro Expedition. The name is therefore most inappropriate; it appears without description in the account of the flora of the expedition in the Linnean Society's Transactions.

POLYSTACHYA TAYLORIANA, sp. nov. Rhizomate repente; caulibus basi anguste pseudobulbosis et a foliorum delapsorum vaginis cinctis, superne teretibus, in bracteis longis lineari-lanceolatis subscariosis arcte inclusis, supra medium ramos breves floriferos emittentibus; floribus parvis longe pedicellatis; sepalo dorsali oblongo obtuso quam lateralia angustiore his ovato-oblongis basi lata ad pedem columni adnatis mentum conicum formantibus; petalis cuneato-spathulatis quam sepala brevioribus; labello extremo pede a cardine affixo, basi brevi lineari pubescente, in laminam glabram late oblongam erectam mox recurvatam expanso, in apice retuso et margine valde crispato; columna unilineari alata, pede sesquilineari; anthera uniloculari, polliniis 2, adnatis.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

The stout hard rhizome is about ¼ inch in diameter, bearing numerous short thin roots on its under surface and above somewhat close-set erect stems 1¼ to 2 feet long. The base for about 2 inches is swollen into a narrow cylindrical pseudobulb, girt, like the portion above for a short distance, with the scarious sheaths of fallen leaves. The upper part, forming the peduncle, is closely invested with long narrow subscarious bracts, which are 2–2½ inches in length about the middle of the axis, but become continually shorter in the upper floriferous half. The small flowers are borne on short (2–3 lines), about 6-flowered lateral shoots in the axils of minute scaly bracts. The oblong dorsal sepal is narrower than the lateral ones, and 2½ lines long by 1 broad; the lateral are 4 lines long and 1½ broad, ovately oblong, and adnate by a broader base to the foot of the column, forming a chin into the upper part of which fits the thin linear basal part of the lip, ⅔ line long, which is at first parallel to the long foot of the column, but soon expands into the erect, then upwardly recurving broadly oblong lamina (2½ lines long by 1½ broad) with a crisped margin. The lateral petals, shaped like the leaflets of a horse-chestnut, are only 2 lines long. The column has narrowly winged edges, is 1⅕ line long, and becomes gradually broader upwards; the galeate anther measures ½ line from back to front, and is 1-locular with a small partition at the back. The 2 pollinia are adnate in the centre, and separable with difficulty.

A characteristic species approaching the South-African *P. tessellata*, Lindl., but at once distinguished by the very short branches of the inflorescence as well as by its floral characters.

Acampe mombasensis, sp. nov. Planta glabra crassa; folio oblongo-ligulato, apice oblique emarginato; spica breviter racemosa, bracteis brevibus semiorbiculari-ovatis; floribus crassiusculis; sepalo dorsali spathulato-ligulato obtuso, lateralibus simili, his autem angustioribus et oblongo-ligulatis; petalis sepalis subsimilibus sed magis spathulatis; labello basi gibboso, lobis lateralibus brevibus rotundatis in facie superiore pubescentibus, carina intermedia lamelliformi in dentem obtusum in basi lobi centralis terminante, hoc crasso, quinquangulari, obtuso, in margine et facie superiore valde papilloso; columna crassa, unilineari longa.

Hab. Mombasa Island: W. E. Taylor, 1886.

The single leaf present resembles those of *A. pachyglossa*, Reichb. f., but is less linear, it is 8 inches long by 1¼ inch at its greatest width. The fleshy flower-spikes are 3–4 inches long and bear a few short similar branches. The numerous flowers are much larger than in *A. pachyglossa*, but similar in general appearance. The sepals and petals are thick, especially on the veins, with a thinner subtransparent marginal portion; the dorsal sepal is 5 lines long by 2½ broad above, the lateral ones are similar but narrower (2 lines broad) and oblong ligulate; the lateral petals are also similar in length, but more spathulate in shape and 1¾ line at their broadest. The lip is 4½–5 lines long, rotundly gibbous at the base; the lower lobes are short and rounded, pubescent above and separated by a central lamelliform keel which ends in a bluntish tooth at the base of the median lobe, which is fleshy, pentagonal, and obtuse, 2 lines long, and as broad, with the upper surface and margins covered with large irregular papillæ. The short thick column is about 1 line long.

Differs from *A. pachyglossa*, Reichb. f., collected by Hildebrandt (no. 1991) on the mainland near Mombasa, in its much larger flowers, about twice the size, the greater similarity in width between sepals and petals and the very rounded gibbous base of the lip, which in *A. pachyglossa* forms a marked conical projection.

Angræcum arcuatum, *Lindl. in Hook. Comp. Bot. Mag.* ii. p. 204.

Mombasa Island, 1886, and Giryama and Shimba Hills, 1887: W. E. Taylor.

Distrib. South and Tropical Africa.

ANGRÆCUM BILOBUM, *Lindl.*, var. KIRKEI, *Reichb. f. in Gard. Chron.* xviii. (1882) p. 488.

Mkomani, Freretown, Dec. 1, 1885; Chororoni, Rabai, Jan. 1886; Kayabonai, Rabai Hills, April 7, 1886; and probably (leaves only) Kilimanjaro, higher slopes above Morang to 10,000 ft., 1888: W. E. Taylor.

Distrib. East Tropical Africa.

ANGRÆCUM FIMBRIATUM, sp. nov. (Pl. XXXII. figs. 11–13.) Radicibus crassiusculis; caule elongato a foliorum basibus firmis persistentibus obtecto; foliis lineari-falcatis, apice inæqualiter bilobatis; spicis lateralibus pluribus multifloris; bracteis brevibus truncatis amplexicaulibus; floribus inter minores; sepalo dorsali ovali-lanceolato cuspidato, 5-nervio, lateralibus ovato-cordatis 3-nerviis basi sub labelli calcari breviter connatis, apice crasso cuspidatis; petalis linearibus sursum angustatis, apice acutis, 3-nerviis; labelli lobis lateralibus ad calcaris latera brevibus, truncatis, segmento laminæ 3-partitæ medio anguste triangulari velut sepalis lateralibus apice cuspidato et crassiusculo 3-nervio, segmentis lateralibus supra medium irregulariter et patente fimbriatis; calcari lamina plus duplo longiore supra basin conicam tenui, ore late aperto; columna brevi superne late auriculata, rostelli processu post anthesin paullo deorsum extruso; anthera ecristata antice acuta, caudicula plana indivisa.

Hab. Giryama and Shimba Hills: W. E. Taylor, 1887.

The rather thick strong roots spring from the base of the elongated distichous-leaved stem which is almost completely covered with the firm rather thick persistent bases (7–8 lines long) of the leaves and reaches over a foot in length. The linear coriaceous leaf-blades separate in drying, and are 5–6 inches long, 3½–4 lines broad, with a very unequally bilobed apex. The lateral flower-spikes are shorter than the leaves (3½–5 inches long) and bear numerous small flowers in the axils of short amplexicaul truncate bracts ⅔ line long. The open flowers measure about half an inch across. The dorsal sepal is 3 lines long by 1 broad; the larger lateral ones are the same length, but 1½ line broad and connate beneath the spur; the narrow lateral petals are 2⅔ lines long and ½ line broad above the base, gradually narrowing to the acute tip. The lip measures 2½ lines to the tip of the central lobe; it consists of two very short (½ line) lateral lobes on the sides of the broad entrance to the spur and a large 3-partite spreading anterior portion, the median segment of which is entire, narrowly triangular and pointed, while the lateral pair (2 lines long) have their upper portion much cut up and spreading. The spur is 7 lines long, the broad opening (nearly a line from back to front) leads to a broad conical base which passes into the thin tube $\frac{1}{3}$ line in diameter. The column is $\frac{1}{2}$ line long; the beak of the rostellum projects slightly downwards; the anterior cap is pointed in front and has a slight median depression; the caudicle is $\frac{2}{3}$ line long, and has a broad angular base with a narrow tip. The pollen-masses are whitish and globular.

Is near the South-African species *A. bicaudatum*, Lindl., but has larger flowers with a proportionately much larger lip, with the median segment of the spreading lamina narrower and more acute, and the lateral ones much larger.

ANGRÆCUM GIRYAMÆ, sp. nov. Planta egregia; foliis magnis crassiusculis clavatis multinerviis, apice inæquali margine (sicco) revolutis; racemis quam folia longioribus, internodiis validis; bracteis obtusis ovario cum pedicello duplo minoribus; floribus illis *A. superbi*, Thouars, verisimilibus at minoribus; sepalis tribus et petalis lateralibus lanceolatis, sepalis autem lateralibus paulo brevioribus et minus acutis; labello latissimo oblato antice emarginato deinde in apiculum complicatum recurvatum producto, lamella plana anguste trapezoidea a calcaris ore sub medio disci extensa, calcari graciliter curvulo quam labellum vix duplo longiore; columna brevi et crassa, rostelli lobis latis et rotundatis; anthera rotundata vix apiculata, polliniis albescentibus sphæroidiis, caudicula brevi, glandula magna.

Hab. Giryama and Shimba Hills: W. E. Taylor, 1887.

The large thick rigid clavate leaves are 10–11 inches long by $1\frac{3}{4}$ inch in the broader upper portion; in the dried state they are rolled backwards at the margin. The apex is very unequally bilobed, the lobes rounded. The longer of the two racemes is $15\frac{1}{2}$ inches long with 10 slightly hooded blunt bracts, the lower of which are $\frac{1}{2}$ inch long.

The fine flowers measure $2\frac{1}{4}$–$2\frac{1}{2}$ inches across; the sepals and lateral petals are similar, all being lanceolate in shape and more or less thickened at the apex. The odd sepal is slightly broader than the rest and subacute, $15\frac{1}{2}$ lines long by $4\frac{2}{3}$ broad; the lateral sepals are blunter and shorter, 14 by 4 lines; while the larger lateral petals are acute, and 16 by 4 lines. The large transversely oblong lip is 18½ lines broad and 13½ long from the mouth of the spur to the tip of the short recurving apiculus in the centre of the broadly emarginate front; the posterior portion bears a longitudinal raised flat lamella ½ inch long and 1½ line broad in the middle, from which it tapers to a sharp point back and front. The gracefully recurving spur is 2 inches long by ¾ line in thickness. The short thick column is 2 lines long by 2½ thick, the broad and rounded lobes of the rostellum 1 line long. The pollinia are whitish, with a short caudicle ½ line long and a rather large gland (⅓ line across). The roundish, rather flat anther is 1½ line long by 1¾ broad.

An interesting species, falling between *Angræcum eburneum*, Thou. (Bourbon), and *A. superbum*, Thou. (Madagascar); from the former it is at once distinguished by its larger, broadly oblong, emarginate lip, in which it resembles *superbum*; it differs from the latter in having a smaller flower with shorter and proportionately broader sepals and petals and clavate leaves.

ANGRÆCUM SEMIPEDALE, sp. nov. Folio inter minora oblanceolato apice inæquali; racemo multifloro pedali vel ultra, inferne crasso sursum mox tenui; bracteis mediocribus breviter cucullatis; floribus speciosis; sepalo dorsali ovato-lanceolato acuto apiculato conspicue 7-nervio; lateralibus lanceolatis huic similibus sed angustioribus et 5-nerviis; petalis lateralibus late oblanceolatis apice subacutis apiculatis 5-nerviis; labello late obovato margine undulato, apice breviter triangulo apiculato, 9-nervio, basi bi-cristulato, calcari longissimo 7–8-pollicari; columna brevi et crassa, rostelli auriculis magnis et rotundatis; stigmate lato; anthera ecristata, caudicula cuneata 1-lineari.

Hab. Rabai: W. E. Taylor, Jan. 1886.

The only leaf present is 2½ inches long by 11 lines in its broader upper part, with 17 longitudinal nerves. The longest raceme is 13 inches and bears 13 bracts; the few lower internodes are thick but rapidly become slender above the third from the base; the blunt sub-hooded bracts are ¼ inch long. The open flowers measure 1¾ inch across; the ovate-lanceolate dorsal sepal is ¾ inch long by 4 lines broad, the narrower but otherwise similar lateral pair 10 by 3 lines. The broadly oblanceolate petals are ¾ inch by 3½ lines, and have 5 conspicuous nerves with two feebler marginal ones. The broad lip (7 lines long by 6 lines broad) has a crisped margin, especially towards the front, and 9 longitudinal nerves with numerous transverse veinlets, the nerve on each side the median one is raised at the entrance to the spur into a low crest. The long flexuose uniform spur is 7-8 lines long by $\frac{2}{3}$ line in diameter. The short thick column is 1 line long; the large rounded auricles (1 line long) of the rostellum form the sides of the broad open scoop-like stigma. The subgaleate anther, $\frac{1}{2}$ line broad by $\frac{2}{3}$ line high, shows indication of division into two on the upper rounded plain surface. The beak of the rostellum after removal of the pollen-masses projects like a serpent's fang; curving upwards at the base with its pointed apex projecting horizontally; it is $1\frac{1}{2}$ line long. The caudicle is roundly cuneate in shape and 1 line long.

Approaches the West-African *A. apiculatum*, Hook., from which, however, it is at once distinguished by its shortly tipped lip and very long spur; the anther-cap is, moreover, not crested. The leaf is similar in shape to those of *A. apiculatum*. Also near another typical African species, *A. avicularium*, Reichb. f., which has a spur intermediate in length, but the flowers are much smaller, the slender spur is only between 4 and 5 inches long, and the lip narrower with a longer pointed tip.

MYSTACIDIUM sp.

Fruiting specimen without leaves.

Steppes of the Thika-thika, Tana river-basin: J. W. Gregory, July 16, 1893.

VANILLA HUMBLOTII, *Reichb. f. in Flora*, 1885, p. 378, vel aff.

Material insufficient for more accurate determination.

Giryama and Shimba Hills: W. E. Taylor, 1887.

Distribution. Comoro Is.

HABENARIA (§ BONATEA) RABAIENSIS, sp. nov. Herbacea; caule crassiusculo infra medium folioso (foliis tribus ovalibus vel ovatis basi vaginantibus) supra medium laxe paucifloro; bracteis membranaceis acuminatis ovario pedicelloque brevioribus; floribus inter majores; sepalo dorsali ovato subacuto cucullato, quam lateralia oblique oblonga apiculata paulo breviore; petalis lateralibus bipartitis parte postica lineari sepalum dorsale subæquante eoque cohærente, antica multo longiore a basi filiformi falcata, apice recurvo subaristato; labelli tripartiti lobo centrali lobis lateralibus subsimili sed breviore, his angustis petalorum partitionibus anticis similibus, calcari magno crasso conspicue protenso cylindrico; processibus stigmaticis elongatis protrusis supra medium incrassatis verrucosisque sub apice leviter recurvatis; anthera apiculata quam rostellum cucullatum paullo breviore, hujus apice valde apiculato protenso, canalibus tenuibus suberectis.

Hab. Rabai Hills: W. E. Taylor, 1886.

A large-flowered herbaceous leafy plant 10 inches high. The two lower leaves are oval in shape, the lowest 4 inches long by 1¼ inch broad, the next rather smaller and the uppermost much smaller (1¼ inch long) and ovate. A minute bract is present midway between the small leaf and the lowest of the three large flowers. The flaccid membranous long pointed bracts are nearly 1 inch in length, while the ovary with its stalk measures 1¼ inch. The hooded dorsal sepal is 8 lines long; the broadly obliquely oblong lateral sepals with their apiculate falcate tips are ¾ inch long by ¼ inch broad. The posterior segments of the petals form the straight edges of the sepaline hoods, the anterior segments are nearly twice the length (14 lines) and consist of a long filiform base and a broader falcate upper portion (½ line at broadest), passing into a recurving almost aristate tip, they resemble in character the narrow lateral lobes of the lip (1½ inch long); the very similar central lobe is 1 inch long. The thick outwardly curving spur is 1¾ inch long by ⅔ line in diameter, the lower third slightly narrower. The protruded stigmatic processes are 8 lines long, they become thicker and apparently warted in the upper surface above the middle. The hooded rostellum bears an anteriorly projecting apiculus. The narrow anther-canals are 4 lines long.

Approaches *H. Volkensiana,* Kraenz. (e descript. in Engl. Jahrb. xix. p. 244), from Kilimanjaro, in floral characters, but is a much smaller plant with a less striking inflorescence; the Kilimanjaro species being a fine orchid 40–60 cm. high with a long richly flowered inflorescence. The Rabai plant has also longer sepals, petals, and spur.

HABENARIA (§ CERATOPETALÆ) ÆQUATORIALIS, sp. nov. Planta glabra subvalida; caule angulato; foliis radicalibus 2 magnis orbicularibus, caulinis distantibus lineari-lanceolatis vel lanceolatis bracteiformibus superne acuminatis transitumque in bracteas floriferas iis similes sed minores præbentibus; spica ovali vel oblonga; sepalo dorsali ovato obtuso 5-nervio, lateralibus patentibus oblique ovatis subacutis 5-nerviis, quam illud latioribus; petalis lateralibus usque ad basin bipartitis, parte postica lineari-falcata acutiuscula, antica subæquilonga sed angustiore et lobis labelli lateralibus simili; labello 3-partito, lobo medio late lineari 3-nervio acutiusculo, lobis lateralibus vix filiformibus subæquilongo; calcari sesquipollicari subtenui apice acuto; processibus stigmaticis subrectis clavatis antheræ canalibus elongatis paullo longioribus; rostello apice longo acute triangulari supra antheram rotundatam elongato; ovario anguste 6-alato.

Hab. Between Unyamwezi and coast: W. E. Taylor, 1887.

About 20 inches high, with a small obovoid tuber $\frac{3}{4}$ inch long and two large suborbicular radical leaves nearly 3 inches across. Above the basal leaves the angular stem bears a number of distant subpatent bracteiform leaves more or less lanceolate in shape and 1 inch or more in length below, shorter above, and passing into the lanceolate acuminate floral bracts, which are shorter than the narrowly 6-winged ovary. The dense spike is $2\frac{1}{2}$–4 inches long. The flowers are of a fair size, measuring 13 lines from point to point of the lateral sepals. The dorsal sepal is 5 lines long by $2\frac{1}{2}$ broad, the rather larger oblique and more acute spreading lateral sepals 6 by 3 lines. The lateral petals are split down to the base; the narrow falcate posterior segment is $4\frac{1}{2}$ lines long by $\frac{2}{3}$ line broad, the anterior one is almost filiform, 5 lines long by $\frac{1}{3}$ line broad, resembling the lateral lobes of the lip. The lip measures 7 lines from the mouth of the spur to the tip of the median lobe, which is $5\frac{1}{2}$ lines long by $1\frac{1}{2}$ broad, the very narrow lateral lobes are equal to it in length. The narrow spur is $1\frac{2}{3}$ inch long, with a rather long pointed tip. The horizontal and club-shaped stigmatic processes are $1\frac{2}{3}$ line long. The ovary is nearly $\frac{3}{4}$ inch long.

In Kraenzlin's arrangement of the genus in Engl. Jahrb. xvi. p. 52, this plant falls in the Section 3, *Ceratopetalæ*, nearest *H. Welwitschii*, Reichb. f., as the segments of the lateral petals are of almost equal length, while the thickened club-shaped stigmatic processes are only slightly longer than the anther-canals. It, however, differs considerably from this and its near allies in its large broad pair of radical leaves, and larger flowers, with a long spur, in which it resembles *H. Elliotii*, Rolfe, from Madagascar. It resembles very closely in habit and characters of stem and leaf *H. stylites*, Reichb. f. & Moore, from Kilimanjaro, which Kraenzlin places in the next section *Replicatæ*, owing to difference in size between the dorsal and lateral sepals; such difference is but slight in *H. æquatorialis*, while the flowers are larger than in *stylites*, with a broad median lobe to the lip.

HABENARIA (§ REPLICATÆ) PEDICELLARIS, *Reichb. f. in Otia Bot. Hamb.* p. 100.

Hab. Steppes of the Thika-thika, Tana river-basin. Sandy steppes with Acacia scrub in patches: J. W. Gregory, July 16, 1893.

Distrib. Abyssinia.

Of a deeper colour than the type.

HABENARIA (§ REPLICATÆ) NDIANA, sp. nov. Elata; caule terete valido folioso; foliis late linearibus a basi longa vaginante acutis, plicatis, iis supra caulis medium brevibus amplexicaulibus lineari-lanceolatis acuminatis transitum in bracteas præbentibus; spica laxe cylindrica, bracteis membranaceis ovali-lanceolatis acutis pallide bruneis ovarium cum pedicello haud æquantibus; floribus inter mediocres; sepalis reflexis, dorsali ovali lateralibus multo minore, his subrhomboideis apice asymmetrico plicatis, 5-nerviis; petalis lateralibus bipartitis, parte postica parva pæne filiformi, antica lineari-lanceolata superne subulata; labelli tripartiti segmento medio anguste lineari quam lateralia lineari-lanceolata subfalcata paullo longiore, calcari tenui inferne ampliato quam ovarium cum pedicello breviore; processibus stigmaticis haud longis, crassis, capitatis, quam antheræ canales tenues subrecurvati vix brevioribus; rostello subulato antheram rotundatam emarginatam æquante.

Hab. Ndi Mountains, 4400 feet. Acacia scrub broken by gneiss hills: J. W. Gregory, April 1, 1893.

An erect plant 22 in. high, with a stout leafy stem, bearing in the lower half 5 or 6 rather long ascending leaves, with a closely amplexicaul membranous base ($1\frac{1}{2}$–2 in. long) and a broadly linear blade 5–6 inches long and $\frac{1}{3}$–$\frac{1}{2}$ in. broad. In the upper half the leaves are short, bracteiform, linear-lanceolate, sheathing the stem below, and subadpressed in the upper acuminate portion; the lower ones are nearly $2\frac{1}{2}$ inches long, becoming shorter above, and passing into the membranous bracts, the lowermost of which are 1 in. long. The spike is 6 inches long, neither densely nor laxly flowered. The oval dorsal sepal is $2\frac{1}{4}$ lines long by 1 line broad, with a marked midrib; the broad lateral ones are 3 by 1½ lines, asymmetrical, with the apex at the end of the longer posterior side; there are a well-marked midrib and four lateral nerves. The small posterior segments of the petals are narrowly linear-lanceolate (2 lines long by ¼ broad), the inner large anterior segments are a little over 4 lines long by ¾ line broad above the base; the lateral lobes of the lip are about equal to the latter in length, and somewhat similar in shape, though more lanceolate and falcate, and only ½ line at their broadest about the middle. The median lip is narrow linear and 4½ lines long; spur 10 lines long. The sturdy capitate half-ascending stigmatic processes are 1½ line long, slightly shorter than the narrow horn-like recurving anther-canals. Ovary with pedicel 13 lines long.

Approaches the Malagasy *H. incarnata*, Lindl.; but has shorter stigmatic processes which do not exceed the anther-canals; the shape of the sepals is also different. Is also near the Abyssinian *H. humilior*, Reichb. f., but is a taller plant, and has narrower lateral petals; in the latter point it also differs from the nearly allied *H. pedicellaris*, Reichb. f., and further in the length of the bracts.

HABENARIA (§ BILABRELLÆ) ALTIOR, sp. nov. Caule erecto subvalido infra medium a foliis lineari-lanceolatis acutis ascendentibus basi amplexicaulibus pro parte obtecto, his supra caulis medium brevioribus transitum in bracteas præbentibus; spica subobovata subdensiflora; bracteis ovalibus acuminatis, in margine sparse ciliolatis, ovarium cum pedicello haud æquantibus; floribus mediocribus; sepalis reflexis, dorsali a basi angustissima ovali, quam lateralibus multo minore, his oblique obovatis conspicue 3-nerviis apice valde asymmetrico crassiusculo; petalis bipartitis margine facieque superiore hispidulis, parte antica lanceolari-subulata quam postica linearis multo majore; labelli 3-partiti segmentis angustissimis subsimilibus, medio quam lateralia lineari-subulata paullo longiore lineari obtuso, calcari infra medium torto deinde subinflato quam ovarium cum pedicello breviore; processibis stigmaticis longis rectis vel superne vix ascendentibus, crassiusculis, capitatis, quam antheræ canales longi tenues apice sursum curvati vix longioribus; rostello anguste triangulari obtuso antheræ loculos orbiculares æquante; staminodiis bilobis; ovario sæpe fusiformi (præcipue in angulis) verruculoso.

Hab. Higher slopes of Mount Kilimanjaro above Morang to 10,000 ft.: W. E. Taylor, 1886.

An erect plant 15 inches high, with a leafy stem; leaves below the middle narrow from a sheathing base, those above the middle subbracteiform amplexicaul, with a sharply pointed apex, the lowest 20 lines, the next higher 16, the upper ones becoming like the bracts and ciliolate at the margin. The dense spike is 3 inches long; the broad acuminate bracts (the lower 10–11 lines long) are sparsely ciliolate at the margin. The flowers are rather long-stalked, the ovary ($4\frac{1}{2}$ lines) with the pedicel measuring 1 inch in length. The 5-nerved oval dorsal sepal has a large thickened spathulate apex, and measures 3 lines by $1\frac{1}{3}$; the larger very oblique lateral sepals are $4 \times 2\frac{3}{4}$ lines. The small very narrow posterior segments of the petals are scarcely $3\frac{1}{2}$ lines long, with a breadth of $\frac{1}{4}$ line, the anterior are 6 lines by $\frac{3}{4}$ line, both are minutely hispid. The three lip-segments are very similar to each other; but the median is uniformly linear, blunt, and 7 lines long, while the more pointed lateral ones are 6 lines; their breadth is less than $\frac{1}{3}$ line. The spur is $\frac{3}{4}$ inch long and slightly dilated below the middle, where there is a slight twist. The generally straight horizontally protruding stigmatic processes are $2\frac{1}{2}$ lines long. The surface of the more or less spindle-shaped ovary is covered with small semiglobose warts which are larger on the angles.

Is very near the Abyssinian *Habenaria Schimperiana*, Reichb. f., but has not the characteristic much twisted spur, while the flower-spike is short and dense, and the bracts larger, broader, and ciliolate.

HABENARIA (§ MULTIPARTITÆ) SPLENDENS, sp. nov. Planta glabra, egregia; caule crasso omnino folioso; foliis basi vaginantibus, lamina ovata subpatente et apice acuta; spica vix densa, bracteis imis magnis ovatis foliaceis ovarium superantibus, ceteris similibus (vel magis ovalibus), acutiusculis et brevioribus, ovarium vix vel haud æquantibus; sepalo dorsali ovato minute apiculato cum petalis lineari-falcatis acutis adhærentibus galeam formante, sepalis lateralibus patentibus oblique ovatis, apice acuto plicato; labello superne minute hispidulo a basi lineari trifurcato, segmento medio longiore filiformi, lateralibus latioribus curvatis margine exteriore laciniatis, laciniis simplicibus; calcari recurvato crasso ovarium superante; processibus stigmaticis longis supra medium leviter ascendentibus, apice velut in *Habenaria macrantha* dilatatis, antheræ canales tenues superantibus; anthera *H. macranthæ.*

Hab. Kilimanjaro, 6000 ft: H. H. Johnston (*H.* aff. *H. macranthæ*, Hochst. in Trans. Linn. Soc. ser. 2, ii. p. 349); Kilimanjaro, Mochi, 4000–5500 ft., and higher slopes above Morang to 10,000 ft.: W. E. Taylor, 1888.

A fine-looking plant 13–20 inches in height, with the thick stem leafy right up to the spike. The leaves have a closely-sheathing base 1 inch or less in length, and a spreading ovate or ovate-lanceolate blade 3–4 inches long by $1\frac{1}{2}$ inch or more broad in the larger specimen. The sessile lower bracts resemble the leaf-blades in shape, though much smaller in size; they become smaller as we ascend the spike, the upper ones being shorter than the ovary. The broad spike is 5–6 inches long, and bears ten or fewer very large flowers. The dorsal sepal is 1 inch long by $6\frac{1}{2}$ lines broad, with a conspicuous midrib, and six well-marked lateral veins united by transverse venules. The lateral sepals are 14 lines by $5\frac{1}{2}$, similarly veined to the dorsal, the posterior side is almost straight. The lateral petals are 14 lines long by $2\frac{3}{4}$ at their broadest below the middle, acute, 4–5-nerved, and form the margins of the dorsal helmet. The lip is $1\frac{1}{2}$ inch from its insertion to the end of the almost filiform median lobe; the linear base broadens above at the trifurcation. The median lobe is 1 inch long; the broader lateral ones $\frac{3}{4}$ inch long by $\frac{2}{3}$ line broad below the middle. The recurving spur is 17 lines long, becoming subcylindric above the wider base. The ovary is 14 lines. The stigmatic processes are 10 lines long, dilated at the ends, as in *H. macrantha*, in the shape of a foot which is papillose on the upper surface. The lower part is adnate to the anther-cells, the canals of which are thin and narrow.

Is very near the Abyssinian *H. macrantha*, Hochst.; but differs in several minor points, having slightly narrower, more spreading leaves, slightly larger flowers with larger sepals, narrower longer lateral petals, and the labellum hispidulous on the upper surface, with an almost filiform median segment. The bracts are also shorter and more ovate, while the spur exceeds the ovary in length.

HABENARIA (§ PLATYCORYNE) TENUICAULIS, sp. nov. Planta minor; foliis basalibus . . . .; caulis tenuis foliis paucis linearibus

acutis bracteiformibus distantibus; inflorescentia pauciflora *H. croceæ*, bracteis ovatis acutis ovario pedicelloque tenui circiter duplo brevioribus; floribus inter minores; sepalo dorsali late ovato acuto cucullato, lateralibus reflexis (?), a basi brevi angustissima lineari-oblongis, sub apice acuto inæqualiter plicato vix angustatis; petalis lateralibus falcatis acutis, ad sepalum dorsale adnatis, galeæ latera efficientibus; labello ligulato obtuso supra basin utrinque obtuse angulato marginibus valde reflexis, calcari tenui recto basin versus vix ampliato ovarium cum pedicello subæquante; processibus stigmaticis crassiusculis compressis a basi tenui ovato-subrhomboideis; antheræ canalibus ascendentibus latis truncatis quam processus paullo longioribus, rostello triangulari ad antheram erectam sublongiorem valde apiculatam parallelo.

Hab. Unyamwezi to coast: W. E. Taylor, 1887.

The very slender stalk measures 1 foot below the inflorescence, and bears five linear upwardly narrowing acute bracteiform leaves (1–1½ inch in length) with a sheathing base, separated by long internodes. The short corymbose raceme is 1½ inch long, the ovate acute bracts 4–5 lines. The hooded dorsal sepal measures 4½ by 3 lines; the shortly stalked lateral sepals (5 by 1⅕ line) are 5-nerved in the lower two thirds of their length, and become slightly narrower in the upper third towards the unequally plicate acute apex. The 3-nerved lateral petals are 4 lines long by ¾ line broad, and adherent to the dorsal sepal, helping to form the sides of the hood. The narrow lip (4½ by scarcely ⅔ line) is slightly angled on either side above the base, and has the sides strongly deflexed; the thin spur is 7 lines long, equal in length to the ovary with its thin pedicel. The short (1½ line) stigmatic processes consist of a vertically compressed subrhomboid anterior part on a thin stalk. The erect strongly apiculate anther is 2½ lines long, the triangular rostellum which stands in front and parallel with it is just over 2 lines, the broad truncate canals project slightly beyond the stigmatic processes.

Resembles *H. crocea*, Schweinf., in habit, but has larger flowers; and also differs in the shape of its stigmatic processes, in its apiculate anther, and other details. Approaches very nearly to *H. Buchananiana*, Kraenz. in Engl. Jahrb. xix. p. 247; but differs in having the lip longer and angled above the base, the spur scarcely inflated, while the huge anther-canals and rostellum are also distinguishing characteristics.

Peristylus hispidula, sp. nov. Planta omnino breviter sed dense hispidula; foliis ovalibus superne lanceolatis acuminatis; spica usque pedali, densa; bracteis anguste lanceolatis acutis pedicellos æquantibus vel sæpissime superantibus; sepalis lateralibus patentibus (?) oblique ovatis 3-nerviis, apice crassiusculis integris, dorso minute pubescentibus, dorsali ovato simili sed haud obliquo cum petalis supra antheram connivente; petalis oblongis 1-nerviis vel partim 2-nerviis obtusis integris; labelli lamina triloba, lobis rotundatis basi breviter rotunde saccata, lateralibus medio duplo longioribus, calcare scrotiformi 1-lineari alto; antheræ loculis parallelis basi haud divergentibus apice rotundis, connectivo haud prolongato, glandulis nudis contiguis sed rostello intermedio in processum subulatum breviter continuato.

Hab. Nyasaland, 1891: Buchanan, no. 572.

The plant, which is 20 inches or more in height, is covered with very short stiff brown hairs; the leaves are $1\frac{1}{2}$ inch long and 3–5 lines broad, the dense spike reaches a foot in length, and the narrowly lanceolate pointed bracts are equal to or longer than the flower-pedicels. The obliquely ovate lateral sepals are $3\frac{1}{2}$ lines long by 2 lines broad; the dorsal, 3 lines by $1\frac{2}{3}$, meets the lateral petals above the anther, these being oblong, $2\frac{1}{2}$ lines long by $1\frac{1}{2}$ broad. The lip broadens rapidly from a narrow base, and is 4 lines long by 4 lines at its broadest anteriorly, where it is 3-lobed, the lobes rounded, and the central one half the length of the two lateral. The scrotiform spur is 1 line deep.

Var. **minor**. Planta minor pedalis foliis ovalibus acuminatis; spica semipedali; bracteis pedicellos æquantibus quam folia minoribus, iis autem similibus vel magis lanceolatis; florum partibus quam in typo minoribus.

Hab. Woods on hills N.E. of Kariandusi, east of camp 44, 7000 ft.: J. W. Gregory, May 9, 1893.

Differs from the type in the smaller size of the plant, which is 11–13 inches high, with more oval broader leaves $1\frac{1}{4}$ line long by 5–6 broad. The dense spike is 6 inches long, while the parts of the flower are also smaller. The lateral sepals measure 3 lines by $1\frac{2}{3}$, the dorsal 2 by $1\frac{1}{2}$, the lateral petals 2 by 1, while the lip is $3\frac{1}{2}$ lines long and barely 4 across.

Disa Gregoriana, sp. nov. Planta glabra robusta; caule crasso, a foliis sensim in bracteas transeuntibus obtecto, illis plus minus lanceolatis acutis multinerviis rubescentibus amplexicaulibus; spica densissima oblonga, bracteis acuminatis flores paullo superantibus, his inter mediocres; sepalis lateralibus suboblique lateque oblongis obtusis, dorsali obtuse cucullato postice in calcar cylindraceum curvatum subacutum triplo longius producto; petalis lateralibus ligulatis subfalcatis obtusis erectis inclusis; labello lineari-spathulato obtuso 3-nervio; antheræ loculis suborbicularibus.

Hab. Terminal moraine of sheet-glaciation, 10,400 ft., Mt. Kenya, July 3, 1893: J. W. Gregory.

A robust plant 14–16 inches high, the thick soft reddish stem almost completely hidden by the sheathing leaves and bracts. The basal leaves are lanceolate and subpatent from a sheathing membranous base, more or less acute, folded at the midrib with about eight darker dorsally conspicuous veins on each side, 5–6 inches long by about 1 inch broad. The stem-bracts are ovately lanceolate acute, or almost acuminate and closely adpressed, and form a transition from the basal leaves to the narrower oval-lanceolate, lanceolate, or almost oblanceolate acuminate bracts, 12–14 lines long and 2½–4 lines broad, slightly exceeding the flowers in length. The broad, somewhat oblique lateral sepals are a little over 4 lines long and half as broad, and 5-nerved; the dorsal hood is 3¾ lines high, and posteriorly produced at the base into a long gracefully curving cylindrical spur slightly pointed at the tip, 10 lines long by ⅔ line wide. It shelters the erect narrow slightly falcate lateral petals, which are 3-nerved, obliquely inserted at the base, and 3½ lines long by ¾ line broad. The obtuse lip is 3½ lines long by ⅘ line wide in the upper, broader portion. The rounded anther-cells are ¾ line long.

Approaches *Disa Welwitschii*, Reichb. f., from Angola; but is a larger, coarser plant, more resembling the southern *D. Cooperi*, Reichb. f., in habit. The flowers are about the same size as in *D. Welwitschii*; but are at once distinguished by the larger spur, the broader labellum, and narrower lateral petals.

Disa kilimanjarica, sp. nov. Planta glabra mediocris; caule rufescente foliato; foliis lineari-loratis, obtusiusculis, superne diminutis, lanceolatis et acutis, transitum in bracteas præbentibus; spica densissima ovali-oblonga; bracteis ovato-lanceolatis acuminatis ovarium paullo superantibus; floribus inter minores; sepalis lateralibus suboblique ovato-oblongis 3-nerviis, dorsali subcucullato obtuso calcar dorsale haud longum obtusum emittente; petalis lateralibus lanceolatis vel ovati-lanceolatis obtusis vel acutis 3-nerviis; labello lineari angusto; columna brevissima, anthera ovali quam petala paullo breviore.

Hab. Higher slopes of Mount Kilimanjaro above Morang to 10,000 ft.: W. E. Taylor, 1888.

Eight inches to a foot high, the basal leaves sometimes reaching 5 inches in length with a breadth of half an inch, the upper much shorter and more lanceolate or ovate-lanceolate in shape and pointed; all half-spreading. The very dense spike more or less oblong in shape, $1\frac{1}{4}$–2 inches long, the acuminate bracts about half an inch long in the middle of the spike. The blunt lateral sepals $2\frac{1}{2}$ lines long by $1\frac{1}{2}$ broad, the dorsal slightly hooded (aperture 2 lines in height), emitting from below the middle of the back a blunt spur $2\frac{2}{3}$ line long by $\frac{1}{3}$ line thick. The short slender lip is scarcely $1\frac{1}{2}$ line long and only $\frac{1}{5}$ line broad; the lateral petals, $1\frac{1}{2}$ line long by $\frac{2}{3}$ line broad, are sometimes obtuse, sometimes acute.

Near *Disa polygonoides*, Lindl., but differs in its longer spur and narrower lip. Must be very close to *D. Deckenii*, Reichb. f., in Otia Bot. Hamb. p. 105, from the same locality, which I have not seen, but the petals of which are described as oblong and aristate.

DISPERIS KILIMANJARICA, sp. nov. (Pl. XXXII. figs. 8–10.) Plantula glabra; caule tenuissimo e tubere ovoideo, viridi, basi vaginato; foliis 3 caulinis superne decrescentibus basi vaginantibus, lamina cordata acutiuscula; flore solitario terminali; sepalo dorsali galeato a posteriore obtuse saccato, lateralibus oblique anguste obovatis apiculatis lateribus contiguis saccatis; petalis cum sepalo dorsali æquilongis agglutinatis, galeæ latera hyalina præbentibus; labello sub apice lineari sursum curvato, lamina apicali ovata cum sacco basali elongato; antheræ rotundatæ processibus lineari-oblongis.

Hab. Kilimanjaro, higher slopes above Morang to 10,000 ft.

A tiny one-flowered plant, 3 inches high, springing from an ovoid tuber and sending out just at its origin filiform tuber-bearing underground shoots. Of the three bright green cordate leaves, the lowest is 7 lines long by 5 broad; the upper are smaller, while the uppermost is situated at the base of the ovary. The hooded dorsal sepal measures 3 lines along its straight base to the end of the blunt posterior sac, and 3½ lines from the acute anterior tip to the same point. The lateral petals with their rounded apex form a hyaline margin to the hood 1½ line long. The spreading lateral sepals are 3 lines by 2, with a narrow lateral sac on the inside. The narrow lip is 3 lines long, curving upwards and then outwards, and terminating in a dark-coloured ovate blade, behind which at the base is a dark-coloured pitcher-like sac.

Closely resembles the South-African *Disperis Macowani*, Bolus, but differs in being a glabrous plant with a larger flower; also in the bluntly spurred dorsal hood, while the lip, though linear, has a much shorter, more inflated terminal spur.

HÆMODORACEÆ.

SANSEVIERIA CYLINDRICA, *Boj. Hort. Maurit.* p. 349.
Rabai Hills: W. E. Taylor, 1885.
Distrib. Tropical Africa.

SANSEVIERIA cf. GUINEENSIS, *Willd. Sp.* ii. p. 159.
Material insufficient for certain determination.
Konje, Kisulutini, Rabai Hills: Taylor, Sept. and Oct. 1885.
Distrib. Tropical Africa.

ROMULEA ALPINA, sp. nov. Herba humilis glabra; bulbo globoso; foliis evolutis 4, setaceis, scapum florentem longe superantibus; pedunculo terete solitario brevi unifloro, fructifero elongato; spathæ valvis consimilibus substramineis lanceolatis subacutis; perianthii infundibuliformis tubo bilineo luteo, segmentis oblanceolatis violaceis quam stamina duplo longioribus; filamentis in tubo sub fauce insertis, antheris styli ramos superantibus.

Hab. Higher slopes of Mount Kilimanjaro above Morang to 10,000 ft.: W. E. Taylor, 1888.

A small plant not exceeding 5 inches in height, with a brown globose corm ⅓ inch in diameter, and four very narrow setaceous falcate leaves 4–5½ inches long, with a strong midrib. The peduncle is 1½ inch long in the flowering state, but elongates to 4½ inches in the fruit; the two spathe-valves are similar, straw-like in consistence and striate, the outer 6½ lines long, the inner half a line less; the short perianth-tube (2 lines long) is a golden yellow, the delicate subobtuse segments are a pale violet with deeply coloured veins, and measure 5 lines in length by a little over 1 line in breadth; the yellow linear-sagittate anthers are $2\frac{1}{2}$ lines long.

Approaches very nearly *Romulea gracillima*, Baker, described from a plant collected by Drege in the mountains of Namaqualand; but is distinguished by its non-acuminate spathe-valves and much shorter perianth-tube; the flower of *gracillima* is, moreover, described as pale red-lilac in colour. Is also evidently related (e descript.) to *R. Fischeri*, Pax, in Engl. Bot. Jahrb. xv. p. 150, described from a plant collected at Abori by Fischer; the latter has, however, much larger spathe-valves and flowers, while the style-branches exceed the anthers.

ARISTEA TAYLORIANA, *Rendle, in Trans. Linn. Soc.* ser. 2, *Bot.* iv. p. 48.

Mount Kilimanjaro, 7000 ft.: H. H. Johnston; higher slopes up to 10,000 ft. above Morang: W. E. Taylor.

HESPERANTHA KILIMANJARICA, sp. nov. Herba glabra; bulbo parvo globoso: foliis ad caulis basin 2, gramineis in costa marginibusque incrassatis, caulinis 2 basi vaginantibus superne autem liberis imisque similibus; caule a spica disticha laxe 4–5-flora terminato, ramum quoque debilem 2-florum in folii vaginantis inferioris axillo emittente; spathæ valva exteriore ovata herbacea, margine anguste hyalina, apice truncata purpureoque suffusa, interiore breviore; perianthii tubo recto angusto superne latiore, segmentis dilutis purpureo-rubris concoloribus ovali-lanceolatis dimidio breviore; styli ramis columna duplo longioribus.

Hab. Higher slopes of Mount Kilimanjaro above Morang to 10,000 ft: W. E. Taylor, 1888.

The small corm is $\frac{1}{4}$ to $\frac{1}{3}$ inch in diameter, the smooth dull brown outer tunic separating above into sharp acuminate teeth. The two basal leaves are firm, linear, tapering above, and $8\frac{1}{2}$–10 inches long by $1\frac{1}{2}$ line broad; the stem, which, including the lax distichous terminal spike, is 16 inches long, bears two superposed leaves, a lower with a sheathing base and a long free portion resembling the basal leaves, and subtending a weak flower-spike, and an upper shorter one at the base of the terminal spike. The outer spathe-valve is 5–6 lines long, larger in the fruit, the inner shorter one has a broader hyaline margin and a narrower blunt apex. The perianth is of a bright claret colour, with a straight narrow tube 3–4 lines long broadening towards the throat, and concolorous, oval-lanceolate obtuse segments 7–8 lines long by 2⅓ lines broad, in the inner series rather narrower. The short filiform stamens are inserted at the mouth of the tube; the anthers are 2½ lines long. The three subulate style-arms are 5 lines long, being twice the length of the undivided part.

Is closely related to *H. alpina*, Benth., from the Cameroons (8000–10,000 ft.), but differs in being a larger, more robust plant with concolorous segments twice as long as the perianth-tube.

Dierama pendula, *Baker, in Journ. Linn. Soc., Bot.* xvi. p. 99.

Hab. Higher slopes of Kilimanjaro above Morang to 10,000 ft.: W. E. Taylor, 1888.

Collected at a similar elevation in 1884 by H. H. Johnston.

Distrib. South Africa; Mount Milanji, Nyasaland.

Lapeyrousia congesta, sp. nov. Herba glabra; bulbo subconico a tunicis rigidis rubro-fuscis cancellatis instructo; caule infra, præter vaginas laxas, nudo; folio spatharumque valvis foliaceis dense confertis suberectis, a basi latiore linearibus apice acutis; perianthii pallidi tubo longissimo anguste cylindrico, segmentis linearibus vel lineari-lanceolatis acutis; staminibus perbrevibus styli ramos haud superantibus.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

The broadly conical corm is ⅓ inch in diameter, the outer tunics are rigid, deep brown, and cancellate. The stem is bare for the lower 1½ inch except for two small lax superposed sheaths, while at its summit the single leaf and the leaf-like spathes are crowded into a dense sessile distichous head. The four outer spathe-valves are linear from a broader sheathing base, with a sharp apex, and 4–5½ inches long, 1½ line broad or less, resembling the single (external) foliage-leaf (4½ inches long); the inner valves are also leaf-like, but smaller. The very narrow perianth-tube is 4–5 inches long, the narrow sharply pointed spreading segments are 14 lines long; the anthers are ¼ inch long, and on a level with the short style-branches.

Is very near *L. odoratissima*, Baker (Huilla, 3800–5500 ft., Welwitsch, no. 1551), in its foliaceous spathes, long perianth-tube, and narrow segments; but in the Angola plant the stem, though short, is not suppressed above the first-produced leaf. The crowding of the leaf and flowers will place the new species in Baker's Section III. *Sophronia*, from all the species of which it differs in its long perianth-tube and large foliaceous spathes.

Acidanthera candida, sp. nov. Herba glabra; bulbo globoso; caule simplici compresso 1–1½-pedali; foliis tribus gramineis subrigidis superpositis; spica laxe 2–4-flora; spathæ valva exteriore viridi basi purpurascente lineari-lanceolata; perianthii tubo longo tenui segmentis candidis late ovalibus, quam stamina duplo longioribus.

Hab. Woodless undulating grass steppes, Lanjoro, Athi plains, East Equatorial Africa: J. W. Gregory, April 22, 1893.

The globose corm is ½ inch in diameter, with tunics somewhat coarsely reticulated upwards. The stiff simple stem, including the lax few- (2–4) flowered spike, is 1–1½ foot long, and bears three linear tapering rigid grass-like leaves with sheathing bases, the two lower 10–12 inches long, much longer than the third. The herbaceous linear-lanceolate outer valve of the spathe is 2–2½ inches long, much shorter than the slender perianth-tube, which is 3½–4 inches long, and about ⅛ inch in diameter at the throat; the broadly oval white segments are 12–14 inches long; the stamens reach about halfway up the limb.

Is very near *A. laxiflora*, Baker, collected by H. H. Johnston in 1884 on the slopes of Kilimanjaro at 2000 feet elevation; but differs in its more robust habit, its firm, narrow linear leaves contrasting strongly with the thin, weak, and often linear-lanceolate leaves of the Kilimanjaro plant, its more linear outer spathe-valve and larger, broadly oval, pure white perianth-segments. Also approaches *A. gracilis*, Pax, from the Zanzibar coast by Mombasa (*Hildebrandt*); but is a larger plant, with longer leaves and spathes and a larger flower. It seems, in fact, intermediate between the coast plant and the species from Kilimanjaro in form as well as in geographical position; the three plants are, however, easily distinguishable.

Note.—*A. gracilis*, Pax, in Engl. Jahrb. xv. p. 154, antedates *A. zanzibarica*, Baker, in Handbook of Irideæ, p. 188; both species are described on Hildebrandt's plant, no. 2015.

Gladiolus (§ **Eugladiolus**) sp., G. Quartiniano, *A. Rich. Fl. Abyss.* ii. p. 307, aff.

Gopo lal Mwari, Laikipia, eastern edge of plateau: J. W. Gregory, June 9, 1893.

Kariandusi, 6100 ft.: J. W. Gregory, May 8, 1893.

Mochi, 4000–5500 ft.: W. E. Taylor, 1888.

Distrib. of *G. Quartinianus.* Mountains of Tropical Africa.

GLADIOLUS (§ EUGLADIOLUS) sp., G. corneo, *Oliver in Trans. Linn. Soc.* xxix. p. 155, t. 100, aff.

Between Zanzibar and Uyui: W. E. Taylor, 1886.

Distrib. of *G. corneus.* Mountains east of Lake Tanganyika.

GLADIOLUS (§ EUGLADIOLUS) TAYLORIANUS, sp. nov. Planta glabra elata; bulbi globosi fibris parallelis apice intertextis; caule terete basi vaginato superne folioso et minute rubromaculato; vaginis infimis chartaceis, superioribus in folia basi vaginantia supra lanceolata transitum præbentibus; foliis rigidis acuminatis, costa media marginibusque incrassatis; spica simplici secunda 5–7-flora; spathis distantibus, valvis æqualibus ovatis, superne lineari-oblongis acuminatis vix aristatis; perianthii tubo anguste infundibuliformi curvato rubro-striato, segmentis horizontalibus tubum paullo excedentibus, 3 superioribus orbiculari-ovatis apice retuso mucronulatis luteis (?) pallide roseosuffusis, dorsali cucullato lateralia superantibus; 3 inferioribus luteis multoties minoribus obovatis anteriore recurvato apice rotundatis; staminibus segmenta inferiora superantibus; stylo antheras superante a stigmate trifido coronato.

Hab. Rabai Hills: W. E. Taylor, 1886.

A fine plant 2½ feet high springing from a globose corm about 1 inch thick with tunics of parallel fibres becoming interwoven at the top. The stem bears a number of basal sheaths, the (two) outer short obtuse and papery, the (two) inner becoming longer, acute to acuminate and foliaceous, and followed by the basal foliage-leaf, which has a long chartaceous sheath (6–7 inches), passing gradually into a rigid broadening lanceolate blade (greatest width 11 lines) with an acuminate apex; there is another similar cauline leaf and an upper smaller one. The rather lax spike is a foot or more in length; the two spathe-valves are equal in length (1¾–2¼ inches in the lower half of the spike, and ⅓–½ inch broad); the curved perianth-tube is 1¾ inch long, less than 3 lines in diameter at its mouth, the dorsal upper segment is 1¾ inch long and 1¼ inch broad, the two more orbicular lateral ones 1½ inch long by 14 lines broad; the three inferior segments are 1 inch long and half as broad. The tube is finely and closely spotted with red, and there are a few red blotches about the mouth; the segments have probably been yellowish suffused with a pale rose-colour.

Near the wide-spread Tropical African *G. Quartinianus*,

A. Rich., but distinguished by its broad lanceolate foliage-leaves and larger flowers.

GLADIOLUS (§ EUGLADIOLUS) SPLENDIDUS, sp. nov. Planta glabra elata; caule terete robusto folioso; foliis rigidis gramineis, nervo medio et marginibus incrassatis; spica simplici, secunda, 8-flora; spathis distantibus, valvis longis lineari-acuminatis, interiore minore; perianthii tubo infundibuliformi, superne curvato, segmentis horizontalibus, tubum superantibus, valde inæqualibus, 3 superioribus obtusis coccineis, dorsali cucullato obovato-spathulato, lateralia ovata apiculata paullo superante, 3 inferioribus multoties minoribus coccineis basi autem luteis (?), lateralibus spathulatis, anteriore recurvato oblongo; filamentis longis antheras multo superantibus.

Hab. Higher slopes of Mount Kilimanjaro above Morang to 10,000 ft.: W. E. Taylor, 1888.

A fine plant reaching a height of 45 inches, with a smooth straight stem bearing a basal and three cauline linear tapering grass-like leaves, the lowest cauline 2 feet long and 4 lines broad, the upper ones shorter; the straight secund spike is 15 inches long, and bears eight splendid crimson flowers; the outer and larger of the broadly linear acuminate spathe-valves is 3–3¼ inches long in the lower half of the spike; the funnel-shaped curving tube is 1¾ inch long with a diameter at its mouth of about 4 lines; the odd upper perianth-segment is the largest, reaching 2½ inches in length by 20 lines in breadth, the upper lateral segments 2 inches by 17 lines; the lower lateral segments are 14 lines long and half as broad, the odd recurved anterior one equal in length, but slightly narrower (½ inch). The stamens reach to within 1 inch of the top of the uppermost segment, and are on a level with the lower lateral segments. The anthers are 7 lines long, much shorter than the long filaments.

Evidently (from the description) closely allied to *G. kilimandscharicus*, Pax, which, however, differs in having broader (7 lines) bluish-green subglaucescent leaves, much broader (7 lines) lanceolate spathe-valves, and narrower floral segments.

GLADIOLUS (§ HOMOGLOSSUM) WATSONIOIDES, *Baker, in Journ. Linn. Soc., Bot.* xxi. p. 405.

Mount Kenya, 10,400 ft., terminal moraine of sheet-glaciation, alpine pasturage: J. W. Gregory, July 3, 1893.

Distrib. Mount Kilimanjaro, 8000–13,000 ft.

AMARYLLIDACEÆ.

HYPOXIS ANGUSTIFOLIA, *Lam. Encyc.* iii. p. 182.

Fimbini near Rabai: W. E. Taylor, Aug. 1885.

Distrib. Tropical to South Africa, Madagascar, and Mascarene Is.

HYPOXIS VILLOSA, *Linn. f. Suppl.* p. 198.

Between Zanzibar and Uyui: W. E. Taylor, 1886.

Distrib. South Africa to Abyssinia.

HYPOXIS LAIKIPIENSIS, sp. nov. Elata; tubere . . . . ; foliis supra basin longe vaginantem linearibus superne ad apicem tenuem angustatis, utrinque (facie autem superiore sparse) villosis, pedunculos superantibus; his pluribus complanatis superne cum racemis, pedicellis, bracteis floribusque dense cinereo-albo-(inflorescentia juvenili argenteo-) villosis; racemis gracilibus 10-floris; bracteis lineari-subulatis quam flores dimidio brevioribus; pedicellis sublongis; florum segmentis externis extus villosis lanceolatis acutis, internis subovalibus subacutis, dorso solum infra medium pilosis; staminibus quam segmenta duplo brevioribus, filamentis subulatis brevibus, antheris sagittatis quam filamenta plus duplo longioribus.

Hab. Steppes cut up by deep ravines, west of Alng'aria, Laikipia: J. W. Gregory, June 10, 1893.

A fine plant over two feet high, the long narrow leaves, 6 in number, reaching a length of 28 inches, with a breadth of scarcely half an inch. The lower surface and margin is tomentose, the upper surface only sparsely so. The flattened peduncles (5 in number) are as much as 1½ ft. long below the raceme, which is about 5 inches in length and bears 10 ascending flowers. The upper part of the peduncle, the axis of the raceme, the pedicels, the back of the bracts, the ovary, and the back of the outer series of perianth-segments are densely covered with long greyish-white ascending hairs; on the young inflorescence the hairs are silvery white. The lower bracts are 12–13 lines long, the lower pedicels ¾ in., the upper shorter in each case. The turbinate ovary is between 2 and 3 lines long; the outer perianth-segments 8 lines long by 2⅓ broad, the inner 7 lines long, and equal to the outer in breadth. The short subulate filaments are 1¼ line long, the sagittate anther 3 lines. The hairs on the ovary are about two lines long.

Is near *H. polystachya*, Welw. (Huilla, Angola), but differs in its longer narrower leaves, hairy on both surfaces, longer peduncles, and its more slender graceful raceme.

Hypoxis Gregoriana, sp. nov. Planta villosa; tubere . . . ; foliis adultis 8 anguste lineari-lanceolatis apice acutis dorso et margine flaccide villosis, facie sparse pilosis; pedunculis 5 quam folia brevioribus, supra basin glabram sparse pilosis, superne velut pedicellis bracteis floribusque flaccide albido-villosis; inflorescentia corymbosa pauciflora, bracteis lineari-subulatis pedicellos inferiores longos haud æquantibus; perianthii segmentis exterioribus lanceolatis apice vix cucullatis et ciliolatis, interioribus ovato-lanceolatis subacutis; filamentis subulatis, antheris sagittatis longis; ovario obconico; capsula medio circumscissa, seminibus glabris, nigris, globosis.

Hab. Platform on Kikuyu escarpment, Kedong: J. W. Gregory, April 30.

The rather flaccid leaves reach nearly 1½ feet in length, with a breadth of about 8 lines near the middle; there are 4–5 fairly conspicuous nerves on either side the midrib, which, like the margins, is densely villose. The back of the leaves is also villose, while the upper surface is only sparsely hairy. The peduncle is about 1 foot long below the short corymbose 4-flowered inflorescence (1¾ in. long); the upper part is clothed with the long ascending whitish hairs, 1½–2 lines long, such as occur also on the bracts and flowers. The slender bracts are about ½ in. long, the lower flower-pedicels reach an inch. The outer perianth-segments are villose on the back, and 7 lines long by 1⅔ broad, the inner are villose only where unprotected on the back by the former, and are 6 lines long by 2½ broad. The short, strong, pointed filaments are 1¾ line long; the long sagittate anthers 3½ lines. The ovary is 2¼ lines long. The capsule is about ¼–⅓ in. long; the smooth dully polished roundish black seeds are 1 line long. Of similar habit to the last species, but differs in its shorter, more linear-lanceolate leaves and few-flowered corymbose inflorescence.

Crinum, sp.

Material much damaged; evidently a fine plant. Leaves 1½–2 ft. long, and nearly 2 in. broad from a narrower base; flowers 7–8 in. long; the long perianth-tube broadening above; pedicels ½ in. long.

Miviruni; Naivasha and Baringo Valley; Nyuki river-basin: J. W. Gregory, May 12, 1893.

HÆMANTHUS MULTIFLORUS, *Martyn, Monogr. cum Icon.*
Kisulutini, Rabai: W. E. Taylor, March 1886.
Distrib. Tropical Africa.

VELLOSIA (XEROPHYTA) ÆQUATORIALIS, sp. nov. Planta pro genere mediocris; caudice semipedali superne furcato; tunicis nigrescentibus valide sed anguste plicatis; foliis linearibus acuminatis apice plicatis vel involutis, junioribus densissime, adultis minus pubescentibus; pedunculis quam folia brevioribus unifloris superne viscosis; perigonii segmentis lineari-lanceolatis apice minute falcatis, dorso basi verruculosis utrinque glabris; antheris sessilibus linearibus quam segmenta plus duplo minoribus, superne recurvatis; ovario oblongo-cylindrico dense glanduloso-muricato; stylo crassiusculo antheras vix superante.

Hab. Between Zanzibar and Uyui: W. E. Taylor.

A rather short shrubby plant, with a stout caudex, 7 lines thick, half a foot long below the fork; the uninjured branch is 1½ inch long, and ends in a tuft of leaves. Leaf-tufts also emerge from the axils of several of the upper sheaths on the main stem. The sheaths are more or less truncate, black in colour, and finely but rigidly plicate like a fan. The young leaves are covered beneath with a thick pubescence, which becomes shorter and less dense in the older; the latter reach a length of 5–6 in. (in a non-flowering shoot 10 in.) and a breadth of nearly 3 lines. The thin pedicels are 2 in. long and become minutely glandular-warted like the ovary in the upper portion. The flowers are solitary. The linear-lanceolate segments of the perianth are 13–14 lines long by 2 broad, and generally have 9 longitudinal nerves; the narrow sessile anthers are ½ in. long, and become recurved above. The oblong-cylindrical ovary is 4 lines long by 2 in thickness, and the rather thick style 8 lines long.

Approaches (e descriptione) *Barbacenia tomentosa,* Pax, in Engl. Jahrb. xv. p. 144, from East Tropical Africa, but has rather longer and broader leaves and shorter flower-pedicels. The perianth-segments are shorter and acute, while the ovary is also shorter and not clavate as in the species described by Pax.

DIOSCOREACEÆ.

DIOSCOREA (§ HELMIA) TRIPHYLLA, *Schimp. ex Kunth, Enum.* v. p. 436.
Rabai Hills: W. E. Taylor, 1886.
Unripe fruiting specimen only.
Distrib. Abyssinia.

LILIACEÆ.

ASPARAGUS ÆTHIOPICUS, *Linn. Mant.* p. 63.
Rabai Hills: W. E. Taylor, July to Sept. 1885.
Distrib. Tropical and South Africa and Madagascar.

ASPARAGUS sp., A. africano, *Lam. Encyc.* i. p. 295, aff.
Jomvu, Rabai Hills: W. E. Taylor, Dec. 2, 1885.
Distrib. Tropical and South Africa.

ASPARAGUS PLUMOSUS, *Baker, in Journ. Linn. Soc., Bot.* xiv. p. 613.
Morang, Mt. Kilimanjaro, 5000–6500 ft.: W. E. Taylor. Platform on Kikuyu escarpment, Kedong, Naivasha to Baringo Valley: J. W. Gregory, April 30, 1893.
Distrib. South Africa to Mt. Milanji, Nyasaland.

ASPARAGUS RACEMOSUS, *Willd. Sp.* ii. p. 152.
Kisulutini, Rabai Hills: W. E. Taylor, Sept. 1885.
Distrib. Tropics and subtropical regions of Old World.

ASPARAGUS (§ MYRSIPHYLLUM) MEDEOLOIDES, *Thunb. Prodr.* p. 66.
Platform on Kikuyu escarpment, Kedong, Naivasha to Baringo Valley: J. W. Gregory, April 30, 1893.
Distrib. South Africa.

ALOE RABAIENSIS, sp. nov. Acaulis (?) . . .; foliis crassis glaucis rubro tinctis, pedalibus, a basi angustatis, margine a dentibus magnis deltoideis cartilagineo-marginatis sursum versis, apice bruneo pungente dentato; scapo ramoso, floribus sub ramorum apice dense globoso-racemosis; bracteis scariosis late ovatis acuminatis, quam pedicelli persistentes brevioribus; perianthio cylindrico recto pollicari, segmentis lineari-oblongis obtusis, interioribus latioribus; staminibus inclusis, antheris lineari-oblongis; stylo exserto.

Hab. Mgandini, Rabai Hills: W. E. Taylor, Sept. 1885.

The fleshy glaucous leaves, suffused with red, are about 13 inches long, and taper gradually upwards from a base $1\frac{3}{4}$–2 inches broad. The marginal teeth are rather large and distant, 12–15 on each side, and measure $1\frac{1}{2}$ line in length, the brown pungent apex is directed upward. The branches of the fleshy scape are very spreading, about half a foot long, and bear a terminal crowded subglobose raceme, which is about

$2\frac{1}{2}$ inches long and as broad; the scarious light-brown coloured bracts are $1\frac{1}{2}$ line long and about as broad at the base. The persistent pedicels are about half an inch long; the cylindrical perianth is 1 inch long, and in the dried pressed condition $2\frac{1}{2}$–3 lines broad; the segments are 9 lines long, the outer three $1\frac{1}{3}$ line broad, the inner 2 lines, the latter are marked with three median undulating dark lines, the former with generally four less undulating lines; the stamens nearly equal the perianth in length; the linear-oblong anthers are $\frac{1}{2}$ line long.

From the description in Engler's 'Jahrbücher' (xv. p. 471) this species is near *Aloe venenosa*, Engl., from East Tropical Africa, but the marginal leaf-teeth are smaller, as is also the inflorescence, which in Engler's plant has branches 12–20 inches long and racemes 8–14 inches, while the bracts are also much longer and much narrower in proportion.

KNIPHOFIA THOMSONI, *Baker, in Journ. Linn. Soc., Bot.* xxi. p. 406.

Mt. Kilimanjaro, Morang, 5000–6500 ft., and higher slopes above Morang to 10,000 ft.; Arusha and Kahe plains and forests, about 3000 ft.: W. E. Taylor, 1888.

Distrib. Mt. Kilimanjaro.

BULBINE ASPHODELOIDES, *Schult. fil. in Rœm. et Schult. Syst.* vii. p. 444.

Platform on Kikuyu escarpment, Kedong, Naivasha to Baringo Valley, April 30, 1893, and Lake Dumi, Tana, Feb. 13: J. W. Gregory.

Distrib. South and Tropical Africa.

ANTHERICUM (§ PHALANGIUM) ACUMINATUM, sp. nov. Herba glabra; foliis paucis gramineis subtiliter nervatis, margine integris, apice acuminatis; scapo nudo subterete; racemo flexuoso subdenso; bracteis albis scariosis, infimis anguste triangularibus ad apicem longum filiformem productis, superioribus acuminatis; pedicellis brevibus solitariis sub medio articulatis; perianthii albi segmentis lanceolatis, a lineis viridibus medianis 3 notatis; staminibus perianthio vix brevioribus, antheris longis sagittatis, filamentis his brevioribus glabris; stylo filiformi curvato, perianthio subæquilongo.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886. Ngurunga Kifaniko; Taita Mts.: J. W. Gregory, April 3, 1893.

The linear grass-like leaves taper very gradually to the long pointed tip, are folded at the midrib, and show a fine longitudinal venation, 10–11 veins each side the midrib; they are 7–12 inches long, 2–3 lines broad. The scape is 10 inches long below the raceme ($2\frac{1}{2}$–$3\frac{3}{4}$ inches). The lower bracts are drawn out into a long filiform, often recurving apex; the lowermost reach a length of 1 inch, but they become shorter upwards and acuminate, measuring only 2 lines in length. The pedicels are about 1 line long. The white perianth-segments have three central green lines, and are $5\frac{1}{2}$ lines long; the stamens are very slightly shorter; the large anthers are $3\frac{1}{2}$ lines long, the filaments shorter.

Approaches *Anthericum uyuiense*, mihi, and *A. Grantii*, Baker, from the same district as Taylor's plant, but is easily distinguished by the very long lower bracts; the scape, moreover, is not flattened.

ANTHERICUM (§ PHALANGIUM) GIRYAMÆ, sp. nov. Herba glabra; rhizomate valido, fibris radicalibus densis crassiusculis; foliis plicatis late linearibus utrinque attenuatis rigidis multinerviis basi membranaceis vaginantibus; scapo aphyllo valde complanato anguste alato folia superante; paniculis paucis compressis in bractearum axillis distantibus; florum bracteis late ovatis vix acuminatis rubris; perianthio rubro-suffuso, segmentis 5–7-nerviis, exterioribus oblongo-lanceolatis apice saturate coloratis, interioribus oblongis quam exteriora latioribus, minus coloratis et margine hyalina latiore; filamentis albis glabris complanatis; antheris magnis flavis lanceolatis; stylo filiformi haud exserto.

Hab. Giryama and Shimba Hills: W. E. Taylor, 1887.

The leaves are three in number, a foot and a half long and 1 inch at the broadest; they are folded on the keeled midrib, which, like the leaf-margin, is bordered, and bear 26–28 veins on either side. The scape is 3 feet long by $3\frac{1}{2}$ lines broad, and bears four short lateral condensed panicles each in the axil of a bract, the lowest of which is $1\frac{1}{2}$ inch long and perforated at the base by the axis of the panicle, while the upper portion clasps the scape; the three upper bracts were torn. The floral bracts are 2 lines long, reddish in colour and prominently veined. The perianth-segments are $5\frac{1}{2}$ lines long, the outer ones $1\frac{1}{2}$ line broad, the inner $1\frac{3}{4}$ line. The stamens are shorter than the perianth, the flattened filaments being $1\frac{1}{2}$ line long, and the large yellow anthers 3 lines; the style is 4 lines long.

Approaches *Anthericum milanjianum*, Rendle, from Mt. Milanji, Nyasaland, but differs in having more rigid leaves and short ovate bracts, while the perianth-segments are larger.

ANTHERICUM (§ PHALANGIUM) PURPURATUM, sp. nov. Herba glabra; foliis 4–5-pedalibus linearibus subrigidis sæpe plicatis, apicem versus acutum angustatis, costa media dorso prominula, venis tenuibus lateralibus 11–13; scapo nudo complanato; racemo *A. venulosi*; bracteis parvis ovatis acuminatis purpureis; pedicellis brevibus, sæpe geminis, in medio articulatis; perianthii semipollicaris segmentis albidis basi purpureis et superne purpureo-striatis lineari-lanceolatis; staminibus perianthio paullo brevioribus; filamentis complanatis purpureo-maculatis; antheris linearibus; stylo filiformi breviter exserto.

Hab. Ngurunga Kifaniko, Taita Mts.: J. W. Gregory, April 3, 1893.

The light green subrigid glabrous leaves are 10–13 inches long and 2½–3 lines at their broadest part. Between the entire glabrous margin and the midrib are 11–13 slender, slightly projecting veins on each side. The naked flattened scape measures 10 inches long by 1½ line broad, and bears a raceme 5½ inches long, which resembles that of *A. venulosum*, Baker. Of the small purple bracts the lower are 2 lines long; they become gradually shorter above, from 1 to 1½ line long. The short pedicels are 1½ to 2 lines long. The perianth-segments are about 6½ inches long, crimson-lake below, with striæ of the same colour running up the centre of the upper portion where the margins are translucent. The stamens are barely 6 lines long, and slightly shorter than the perianth; the linear anthers are scarcely 3 lines long, the thin flat filaments are spotted with crimson.

Is very near *A. venulosum*, Baker, collected on Johnston's Kilimanjaro expedition, but is distinguished by its narrower, finely nerved linear leaves with an entire, not ciliolated, margin.

ANTHERICUM (§ PHALANGIUM) SPECIOSUM, sp. nov. (Pl. XXXIII.) Planta speciosa perennis; fibris radicalibus tenuibus flexuosis numerosis; collo radicis setoso; foliis radicalibus 8 distichis membranaceis longis, e basi longa vaginante linearibus, superioribus in laminam planam linearem versus apicem angustatam prolongatis, glabris, margine supra basin interdum breviter pubescentibus; scapis 3 nudis, centrali duobusque lateralibus, complanatis alatis margine breviter ciliolatis, racemis longis superne densis flexuosis; bracteis scariosis rubris margine hyalinis, infimis triangularibus longe acuminatis, sursum et carina dorsali breviter pubescentibus; superioribus ovatis apice acuto pubescente; pedicellis sæpe quinis supra basin articulatis; perianthii segmentis patentibus albis nervis 5–7 purpureis lineatis, linea latiore colore saturatiore utrinque finitis, exterioribus lanceolatis acutis, interioribus latioribus lineari-oblongis obtusis; staminibus quam perianthium brevioribus, filamentis albis subcompressis latis linearibus apice subacutis, antheris leviter basifixis flavis sagittatis superne falcatis; ovario subgloboso angulis tribus vix prominulis; stylo filiformi sursum curvato perianthium superante.

Hab. Uyui: W. E. Taylor, Feb. 1887.

A fine plant, the short perennial rhizome bearing numerous thin, rather soft, flexuose root-fibres; the basal setæ 1 inch long. The short lower leaves have a light brown membranous sheathing base continuous with a green plicate falcate upper portion; the uppermost a long sheathing-base reaching a foot in length and 8 lines broad, and a broadly linear spreading blade equally long and 13½ lines broad, narrowing some distance below the blunt apex, with a midrib and about 56 parallel veins slightly projecting on the back. The flattened central scape measures 19 inches below the raceme, which is 8 inches long by 2½ lines broad; the two lateral scapes are shorter (4 inches long), with a raceme 10 inches in length. The flower-buds are oval in shape and striated with red. The open flowers are nearly 1¼ inch across, the central crimson lines running to a point near the apex of the petals and contrasting sharply with their delicate white border. The pedicels are jointed one-third their length from the base and are 8 lines long. The perianth-segments are ½ inch long, the outer ones 1½ line broad, the inner 2¼–2¾ lines; they are marked with 5–7 crimson nerves with a deeper, broader, more marginal line. The broad linear colourless filaments (2½ lines long by ½ line broad) bear the long yellow anthers (3½ lines) just fixed on their subacute tip, the point of insertion being in the basal depression. The filiform curved style (½ inch long) surmounts a subglobose ovary. No ripe fruit present.

Is near *Anthericum pterocaulon*, Welw., but differs in having much broader leaves, those of *A. pterocaulon* not exceeding ½ inch in breadth, a longer many-flowered raceme, and longer pedicels jointed nearer the base.

ANTHERICUM (§ PHALANGIUM) UYUIENSE, sp. nov. Herba glabra; fibris radicalibus tenuibus, setis in collo radicis vix uncialibus; foliis 5, linearibus, inferne plicatis superne sæpe planis, margine minute scabridulis, dorso carinatis subtiliter nervatis, basi rubro-maculata scapum amplectentibus; scapo nudo, glabro, folia haud æquante, sub racemo simplici complanato, vix alato; bracteis parvis triangularibus subito acuminatis, floribus paucis in racemum laxum flexuosum ordinatis, solitariis vel inferioribus binis; pedicellis brevibus ascendentibus, infra medium articulatis; perianthii albidi segmentis lineari-oblongis obtusis medio 5-nerviis rubroque tinctis, marginibus late hyalinis, interioribus latioribus; staminibus cum perianthio æquilongis; filamentis albis glabris complanatis; antheris flavis basifixis lineari-lanceolatis; stylo filiformi curvato exserto.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

A slender plant 1–1¾ feet high, emitting a number of long thin wiry root-fibres from the short stem-base. Two or three of the outermost leaves are reduced to little more than sheaths, and, like the exposed bases of the upper elongated leaves, are marked with transverse purplish striæ. The elongated sessile leaves are 20–22 inches long and 2½–4 lines broad, and overtop the simple scape, with its sparsely-flowered flexuose raceme, the latter reaching 4 inches in length. The small, suddenly acuminate bracts are about 1½ line long, the pedicels about ¼ inch. The perianth-segments have a broad hyaline margin and a 5-nerved central strip tinged with red; they are 6½–7 lines long, the inner ones 2 lines broad, the outer 1⅓ line. The stamens are equal in length to the segments, the white flattened glabrous filaments bearing yellow anthers 3½ lines long. The filiform exserted style is almost 7 lines long.

Approaches *A. Grantii*, Baker (in Trans. Linn. Soc. xxix. p. 160), but is glabrous, with leaves more than twice as long, and also differs in floral details; the perianth-segments of *A. Grantii*, for instance, being lanceolate, while the stamens are only about half their length (4–4½ lines).

ANTHERICUM (§ DILANTHES) TAYLORIANUM, sp. nov. Herba cæspitosa; rhizomate duro lignoso nodoso; foliis multis, lineari-lanceolatis, longe linearibus vel ensiformibus, papyraceis, glabris sed in costa media et margine sæpe crispula hispido-ciliolatis, basi membranacea scapum vaginantibus; scapo foliis breviore farinaceopubescente, inferne complanato superne (?) subterete; racemo simplici vix denso; bracteis triangulari-subulatis, margine minute ciliolatis, pedicellos solitarios medio articulatos superantibus; perianthii rotati segmentis lanceolatis albidis, a nervis 3–5 fuscis striatis, quam stamina longioribus; antheris linearibus post anthesin convolutis; polline ovali; filamentis albis subulatis muricatis; stylo filiformi haud exserto; capsulis subacutangulis, seminibus paucis nigris, turgidulis.

Hab. Uyui: W. E. Taylor, February 1887.

A cæspitose plant about a foot in height, the clusters of deep green leaves springing from a much-branched knotted woody rhizome, which bears a number of rather thin, strong, wiry roots. The dried leaves are thin and papery; the outer shorter, lanceolate, sheathing the inner leaves and scape by a broader membranous colourless base; the latter pass through linear-lanceolate to an elongated linear-acuminate shape or are ensiform, 11–14 inches long and 6–8 lines broad above the base, tapering gradually upwards. The midrib is prominent on the lower surface and bears a line of short stiffish hairs; there are 10–16 parallel veins between it and the ciliolate margin, which on the older leaves is crisped. The scape including the raceme is shorter than the leaves (about 1 foot long), and covered with an almost mealy pubescence; the simple raceme is 5–6 inches long. The lower bracts are 8 lines long; the length diminishes upwards to about 4 lines. The slender pedicels are 3 lines long, but become longer (4 lines) and stouter as the fruit ripens. The spreading perianth-segments are 4 lines long by 1 broad, the stamens $3\frac{1}{3}$ lines long, the anthers being 2 lines and curling up after shedding the oval or oval-oblong pollen-grains. Ripe dehisced capsules on a fruiting-specimen were rather sharply three-angled, 3 lines long by $2\frac{1}{2}$ in diameter, and contained a few black turgid seeds each about 1 line across.

Is near *Chlorophytum affine*, Baker, from the same district, but distinguished by its thin ensiform leaves, less dense raceme, and smaller and fewer flowers.

ANTHERICUM (§ HOLPODIUM) GREGORIANUM, sp. nov. Planta humilis habitu *A. angustifolii*, Hochst.; radicibus brevibus crassis, setis tenuibus densis; foliis cum scapis a vagina membranacea tenui basi circumdatis, graminoideis linearibus acutis basi et apice angustatis facie glabris margine breviter ciliolatis; scapis folia vix superantibus nudis subcompressis glabris; racemo corymboso paucifloro; bracteis subscariosis lanceolatis vel superne ovatis plus minus acuminatis quam pedicelli longi duplo brevioribus, his sub flore articulatis; perianthii segmentis lanceolatis albis viride 3-nerviis; staminibus perianthio brevioribus, filamentis filiformibus glabris albis, antheris flavis basi dorsifixis, polline oblongo; ovario conspicue 3-lobo, ovulis in loculis pluribus superpositis; stylo erecto filiformi, antherarum apices haud attingente.

Hab. Kapte plains on banks of the Athi: J. W. Gregory, April 24, 1893.

A small plant 6–7 inches high, with the few (4–5) thin erect narrow radical leaves and the (2) flowering-scapes protected for about an inch at the base by thin bristles, surrounding one or more thin colourless membranous sheaths. The leaves are 5–7 inches long and reach 1½ line in breadth. The surface is glabrous with small scattered rounded elevations, the margins shortly ciliolate. The somewhat slender scape measures 5–5½ inches below the short (1½ inch) few (3–6)-flowered raceme. The lower acuminate bracts are about ⅓ inch long, half the length of the thin flower-pedicels, which are jointed just beneath the flower. The whitish green-nerved perianth-segments are 4⅔ lines long by 1¼ broad. The stamens are 3½ lines long; the yellow anthers (1⅔ line long) are attached laterally at the base to the abruptly pointed tips of the thread-like white filaments. The erect style does not reach the level of the anther-tops.

Is near the Abyssinian species *Anthericum humile*, Hochst., and *A. angustifolium*, Hochst., but is a larger plant than either, with a much elongated flowering-scape, nearly equal to the leaves in length.

CHLOROPHYTUM (§ ANTHERICIFOLIA) ANDONGENSE, *Baker, in Trans. Linn. Soc.* ser. 2, *Bot.* i. p. 260.

Uyui: W. E. Taylor, Jan. 1887.

Differs from the type in having broader lanceolate leaves, but, so far as comparison is possible with the withered flowers of the western plant, the two are specifically identical.

Distrib. Pungo Andongo, West Tropical Africa.

CHLOROPHYTUM (§ CANNÆFOLIA) *cf.* HEYNEI, *Baker, in Journ. Linn. Soc., Bot.* xv. p. 322.

Mombasa Island: W. E. Taylor, 1886.

Fruiting specimen only. Is nearer the East-Indian *C. Heynei* than the Tropical African *Chlorophytum Afzelii*, Baker, as it has the very short scape, the larger fruits, and broader, more numerously nerved leaves of the former. The leaves are in fact broader than in *C. Heynei*, being nearly 2 inches across.

CHLOROPHYTUM (§ CANNÆFOLIA) MONILIFORME, sp. nov. Herba perennis, semipedalis vel infra; rhizomate moniliforme tuberoso; fibris radicalibus paucis fusiformibus; foliis evolutis 3, infimo parvo, basi vaginante, lamina ovata acuta, margine nervisque dorsalibus breviter ciliolatis vel hispidulis; superioribus majoribus, lanceolatis vel ovato-lanceolatis, apice acuto vel acuminato, glabris, margine solum ciliolatis; supremo distincte petiolato; scapo tenui aphyllo brevi simplici, basi a foliis vaginato glabro, sursum pubescente; racemo paucifloro; bracteis scariosis sursum deminutis ovatis basi amplexicaulibus, apice longe acuminatis, nervatis, margine breviter ciliolatis; pedicellis solitariis brevibus sub medio articulatis; perianthii albidi vix semipollicaris segmentis lanceolatis a nervis 3 (rare 4) subfuscis lineatis, exterioribus quam interiora parum latioribus apice subcucullatis; staminibus perianthio brevioribus; filamentis linearibus subcomplanatis; antheris flavis sagittatis basifixis defloratis contortis; ovario breviter oblongo, apice depresso, angulis subprominulis, ovulis in loculo multis superpositis, stylo filiformi flexuoso.

Hab. Uyui: W. E. Taylor, Feb. 1887.

A small plant 4–6 inches high, proceeding each year as a lateral shoot from last season's globose tuber ($\frac{1}{4}$–$\frac{1}{3}$ inch thick), from which it becomes separated by a thin rhizome about $\frac{3}{4}$ inch long and $\frac{2}{3}$ line thick. There are three expanded leaves besides a basal sheath. The first is small, the sheathing-base passing into an ovate acute blade 1 inch long by 7 lines broad; the other two have a more or less lanceolate blade 3–5 inches long, $\frac{3}{4}$–$1\frac{1}{4}$ inch broad, the upper passing into a petiole 1 inch long, the lower into a narrow sheathing-base; they are membranous or almost papery and glabrous, but with a very shortly ciliolate margin; there are 20–30 nerves prominent on the back of the leaf. The short thin colourless scape measures $2\frac{1}{2}$–4 inches below the short simple 5-flowered raceme: above the base, which is sheathed by the leaves, it is softly pubescent. The white scarious bracts have a long acuminate apex, and are longitudinally nerved; the lowest is $\frac{1}{2}$ inch long, the upper are shorter and narrower. The short pedicels are 1¾ line long, and jointed just below the middle. The perianth is 5½ lines long; the outer segments are narrowly lanceolate, 1 line broad, with a slightly hooded tip; the inner are a little broader, with an obtuse apex, and the three nerves are rather wider apart. The white linear filaments are 1⅔ line long, the bright yellow anthers 1½ line; the latter are inserted on the pointed tip of the filament, and become spirally twisted after shedding the pollen. The shortly oblong ovary is 1¼ line long with slightly prominent angles, the filiform style is just over 3 lines in length.

A distinct species of Baker's section *Cannæfolia* (Journn. Linn. Soc., Bot. xv. p. 321).

CHLOROPHYTUM (§ CANNÆFOLIA) FUSIFORME, sp. nov. Herba perennis; rhizomate crasso tuberoso, fibris radicalibus valde incrassatis fusiformibus; foliis 5–6, 3–4 majoribus lineari-lanceolatis raro lanceolatis, acutis, scapum multo superantibus, rigidulis papyraceis in facie superiore glabris, margine nervisque dorsalibus hispidulis; scapo brevi tenui pubescente; racemo 15–16-floro inconspicuo; bracteis scariosis pubescentibus basi ovatis, apice acuminatis valde elongatis; pedicellis solitariis vel binis infra medium articulatis; perianthii segmentis lanceolatis, interioribus latioribus, obtusis 3–5-nervatis; filamentis subulatis, antheris subsagittatis basifixis; ovarii oblongi angulis subprominulis, ovulis multis superpositis.

Hab. Uyui: W. E. Taylor, Feb. 3, 1887.

A small plant 8–10 inches high, with a thick congested rhizome about ½ inch thick, formed by the aggregation of successive tubers, each of which bears a few thickened fusiform roots. The two lowest leaves have a broad membranous sheathing-base and a small falcate blade; the two uppermost pass gradually into a colourless petiole 1¾ inch long, and have a linear-lanceolate blade 6–8 inches long and ½ inch at its broadest; they have a reddish tinge and bear 25–30 shortly hairy veins prominent on the lower surface. The narrow scape is 2 inches long and the raceme 1¾ inch. The lowermost bracts are about ¾ inch long, the upper ones about ¼ inch and less elongated at the apex. The perianth-segments are obtuse, the outer lanceolate, 4½ lines long by 1⅓ broad, the inner are as long as and slightly broader than the outer, with a broad hyaline margin. The colourless subulate filaments are 1½ line long, the yellow basifixed anthers the same length. The ovary is 1 line long; the filiform style 3 lines.

Near *Chlorophytum moniliforme*, mihi, but differs in its much larger congested tuberous rhizome, its narrower linear-lanceolate leaves hairy on the back, and its denser raceme.

CHLOROPHYTUM (§ CANNÆFOLIA) MISERUM, sp. nov. Herba parva; fibris radicalibus subbrevibus fasciculatis apice incrassatis; foliis 4, uno exstante lanceolato, basi in petiolum tenuem latum angustato, glabro, margine autem minute ciliolato, membranaceo, venis 18–20 vix conspicuis; scapo tenui subterete glabro; racemo simplici parvifloro; bracteis lanceolatis longe acuminatis lineatis margine ciliolatis; pedicellis ternis, ascendentibus, tenuibus, supra medium articulatis; perianthio campanulato bilineo, segmentis bruneis oblongo-lanceolatis, nervatis; staminibus perianthio brevioribus, filamentis glabris, antheris parvis; ovario acute 3-lobato, emarginato; stylo longo filiformi, rubro-bruneo.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

A mean-looking plant, apparently annual, bearing a cluster of root-fibres with swollen ends on its shortly thickened axis. No bristles were present round the bases of the leaves, which had been four in number, but only one remained on one of the two flowering specimens. From the appearance of the withered remains the leaves would seem to perish before the plant is in full flower. The single leaf has a thin membranous flattened petiole 1½ inch long, sheathing at the base, and a thin lanceolate acute blade 4½ inches long by 8 lines broad. The very slender scape measures 5½ inches below the thin raceme, which is 3½ inches long, lax below, becoming rather denser above. The long-pointed scarious bracts are 3–4 lines long below, becoming less than 2 above; they are light brown in colour, with generally three thin deep brown nerves. The pedicels are mostly in threes, very thin, and jointed about ⅓ their length from the flower; they are about 2 lines long. The outer segments of the dull-coloured perianth are 2 lines long by ½ line or a little more in width, oblong-lanceolate with a subacute apex; with three (more rarely two) narrow darker brown central nerves which are often quite inconspicuous. The inner segments are very similar to the outer, but more acute, with transparent margins. The stamens are shorter than the perianth; the flattened filaments glabrous, colourless, 1¼ line long; the small yellow lanceolate versatile anthers ½ line. The brownish ovary is sharply three-lobed and emarginate, ½ line long; the reddish-brown style 2 lines.

Approaches the little group of Tropical African species allied to *Chlorophytum amplexicaule*, Baker, but is distinguished from all by its very small flowers.

CHLOROPHYTUM (§ CANNÆFOLIA) RAMIFERUM, sp. nov. Glabra, perennis; rhizomate brevi, collo tenuiter setoso, fibris radicalibus longis sub apice fusiformibus; foliis elongatis lineari-lanceolatis apice acutis, inferne in petiolum plicatum imâ basi vaginantem angustatis, papyraceis 20–24-nerviis; scapo terete, folia superante pauci-ramoso; bracteis membranaceis ramos subtendentibus triangulari-subulatis, floriferis minoribus ovatis apice breviter aristatis; pedicellis tenuibus sæpius ternis apicem versus articulatis; perianthio campanulato 3-lineo, segmentis lanceolatis subacutis bruneis medio lineatis; staminibus perianthium æquantibus vel vix brevioribus, filamentis antheras basifixas superantibus, glabris teretibus sub apice inflatis; ovario oblongo trilobato; stylo filiformi vix perianthium superante.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

The long wiry root-fibres have a thickened fusiform ending, and spring from a short thick rhizome, on the upper surface of which are crowded the 7–9 long, slender, thin leaves, a foot or more in length and 6–8 lines at their broadest. The thin folded petioles have a broad sheathing insertion, and are 2–3 inches long. The leafless scape measures 8–10 inches below the first bract, which is about 1¼ inch long, the upper shorter; the inflorescence is about 10 inches long. The 3–4 branches (4–5 inches) and the longer upper part of the main axis are laxly flowered below, but almost clothed above with the broad ascending floral bracts, which are 4–5 lines long, with 5–7 nerves and a thinner margin, closely enveloping the thin pedicels, which are generally in threes and articulated below the apex. The flowers are small and brown; the outer perianth-segments are 3 lines long by ⅔ line broad, with lighter edges and a brownish centre marked with five dark brown thin lines; the inner are slightly broader, nearly 1 line, with five thin central lines and a broader one parallel to the hyaline margin. The stamens are equal to or scarcely shorter than the perianth; the glabrous colourless filaments (1¾ line long) are cylindrical in the middle, but become swollen beneath the yellow linear basifixed anthers (1–1¼ line in length). The ovary is ½ line long, with three rounded lobes.

Near *C. petiolatum*, Baker (in Journ. Linn. Soc., Bot. xv. p. 326), from the Cameroons, but distinguished by its shorter petioles and narrower leaves, those of the West-African plant having an oblong blade 2½–3 lines broad in the middle, with a deltoid base and petioles 6–8 inches long. *Chlorophytum petiolatum* has, moreover, deltoid bracts much shorter in length (the lower only 1½–2 lines long), and a green perianth with longer (4 lines) segments.

CHLOROPHYTUM (§ DASYSTACHYS) MARGINATUM, sp. nov. Herba subpedalis; rhizomate crasso lignoso annulato, fibris radicalibus crassis, collo radicis parce setoso; foliis 4 lineari-lanceolatis, apice subacutis, basi scapum amplectentibus, plicatis, falcatis, glabris, margine incrassatis dense et breviter hispidis, venis parallelis plurimis conspicuis; scapo glabro aphyllo subterete; racemo denso cylindrico oblongo, bracteis longis subulatis purpureis superne ciliolatis; floribus sessilibus nondum apertis, alabastris ovalibus; perianthii segmentis lanceolatis vel oblongo-lanceolatis pallidis a linea lata media fusca notatis; antheris magnis flavis oblongo-linearibus.

Hab. Uyui: W. E. Taylor, Feb. 3, 1887.

The 1–2 lowest leaves are much reduced, consisting of a membranous sheath and a short falcate blade which is dull crimson in colour; the same colour stains the bases and tips of the upper leaves, which reach 10 inches in length, and are ½–1 inch broad. The short stiff hairs on the thickened margin are reddish brown. There are from 18–22 prominent veins on each side of the projecting midrib. The naked scape is 5–6 inches in length and bears a crowded oblong raceme of 2½ inches. The long subulate bracts, the lower 8–9 lines long, the upper shorter, are of a deep purple colour with their margins ciliolate above. The flower-buds had not expanded, but in one or two of the flowers which were just opening the perianth-segments were lanceolate or oblong-lanceolate, and about 3 lines long. The large yellow anthers measured just over 1 line.

A very distinct species, most resembling *C.* (§ *Dasystachys*) *falcata* (Baker) from Huilla (Welwitsch), but distinguished by the hairy leaf-margin, naked scape, and characteristic purple bracts.

CHLOROPHYTUM (§ DASYSTACHYS) PAPILLOSUM, sp. nov. Perennis; rhizomate lignoso irregulariter incrassato, fibris radicalibus subtenuibus vix densis, collo vix setoso; foliis 9 linearibus utrinque angustatis, basi autem vaginante parum ampliatis, apice acuminatis, facie glabris, margine ciliolatis, nervis parallelis crebris; scapo subterete lævi, quam folia longiore, folium lineari-subulatum infra medium gerente, bracteis sterilibus 1–2-uncialibus triangulari-subulatis a nervis bruneis mediis notatis, margine ciliolatis; racemo denso, bracteis scariosis triangulari-subulatis conspicue lineatis; floribus inter minores subsessilibus; perianthio fusco campanulato dorso dense papilloso, segmentis consimilibus lineari-oblongis, exterioribus apice cucullatis, interioribus obtusis his quoque minus coloratis medioque solum papillosis; staminibus styloque filiformi perianthium longe superantibus; filamentis filiformibus glabris, antheris sagittatis fulvis versatilibus, polline ovali-oblongo; ovario late ovali emarginato 3-sulcato; ovulis multis superpositis.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

A somewhat insignificant plant, springing from a perennial irregularly thickened knotted rhizome 2 inches long, ¾ inch thick, bearing above a few bristles at the position of previous years' shoots, and below root-fibres ½–¾ line in diameter. The two or three lowest leaves are much shorter than the rest, the lowest and shortest being 3½ inches long, while the upper elongated ones reach a foot or even more, with a breadth of 6–7 lines; the slightly dorsally prominent longitudinal nerves are 28–32 in number. The smooth scape measures 18 inches below the rather short (2½ inches) dense narrow raceme; it bears below the middle a narrow tapering green leaf, and between this and the raceme several weak, long-pointed, barren bracts 1–2 inches long, and marked with deep brown longitudinal nerves; the floral bracts are much smaller but of similar shape, and have 1–3 dark brown median nerves, the lowest ¾ inch long, the upper decreasing in size. The solitary pedicels are ½ line long. The brownish campanulate perianth is 3½ lines long; the segments are about 1 line broad, the outer three being slightly hooded at the tip, and papillose over the whole outer surface, especially towards the darker coloured tip; they are marked with three rather dark nerves. The inner segments differ in having a rounded apex and in being dorsally papillose up the centre only, their broader margins are also scarcely coloured. The long filiform filaments measure 4 lines, the versatile dull yellow anthers 1½. The broadly oval ovary is depressed at the apex, where is inserted the slender style; it is 1 line long, and its rounded outline is traversed by three shallow furrows with three less marked alternating with them.

A distinct species, approaching somewhat *Chlorophytum* (§ *Dasystachys*) *colubrina*, Baker, from Angola, but its leaves are larger, twice as broad, and less acuminate than in the Welwitsch plant, which has also a glabrous perianth, whitish in colour with purple streaks.

URGINEA TAYLORIANA, sp. nov. Planta glabra; bulbo crasso globoso; foliis 7 rigidis plicatis lineari-subulatis basi vaginante membranaceis, apice subpungentibus; scapo nudo folia superante subrobusto; racemo denso brevi; bracteis albidis submembranaceis triangulari-subulatis ecalcaratis, pedicellos duplo superantibus; perianthii segmentis spathulato-oblongis albis, nervis centralibus 3 rubris; filamentis perianthio brevioribus complanatis linearibus apice acutis; antheris oblongis versatilibus; stylo recto; capsula globosa.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

A glabrous plant about 16 inches in height, with a large scaly bulb 2½ inches in diameter. The leaves, which are 7–8 inches ong, have a colourless membranous sheathing base and a folded tapering upper portion, 3–4 lines broad in the middle. The smooth shiny scape measures 10 inches below the raceme, which is 3 inches long, and bears a few sterile flower-buds below the crowded oval upper portion. The slender, tapering, almost aristate bracts are 5–6 lines long below, becoming shorter above; the pedicels are 2–2½ lines. The opened flower is nearly 7 lines across. The segments are 3 lines long and 1–1¼ line broad in the upper half, the lower being slightly narrower; they are white, with a reddish central strip traversed by three nerves. The broad flattened filaments are 2 lines long by ⅔ line broad, and bear the yellow anthers (1 line long) on their pointed tips. The ovoid ovary is 1 line long, and the short erect style with its capitate stigma about the same. The subglobose capsule is nearly ¼ inch long, and contains a few flattened black seeds each about 2 lines long and more or less oval in shape.

Is allied to *U. Petitiana*, Solms, from Abyssinia, but is easily distinguished by its very large bulb, shorter rigid leaves, and dense short raceme.

ALBUCA TAYLORIANA, sp. nov. Bulbo ovoideo a vestigiis membranaceis foliorum anni prioris coronato, fibris radicalibus tenuibus; foliis juvenilibus nondum evolutis anguste linearibus scapo longo cylindrico nudo lævi; racemo laxo 12-floro; bracteis albidis scariosis ovatis acutis, nervis mediis convergentibus 3–4 rubro-bruneis notatis, pedicellos solitarios æquantibus vel vix superantibus; perianthii segmentis in medio late purpureo suffusis et lineatis, margine scarioso viridescentibus vel albescentibus, exterioribus late lanceolatis obtusis, interioribus spathulatis quam illa latioribus; staminibus perianthio paullo brevioribus, omnibus fertilibus; filamentis lineari-subulatis supra basin subito expansam constrictis; antheris flavis oblongis versatilibus dorsifixis; ovario ovoideo; stylo cylindrico perianthium æquante, stigmate capitato; capsula ovoidea tenui membranacea semina plura nigra oblonga complanata inclusa exhibente.

Hab. Jomvu, Rabai Hills, Oct. 1885, and Miranakidiri-porini, between Zanzibar and Uyui, Sept. 3, 1886: W. E. Taylor.

The ovoid bulb is 1⅓ inch long by ¾ inch thick, and crowned for a length of 3 inches with the whitish membranous remains of last year's leaves; those of the present season are only beginning to shoot and about 3 inches long. The long smooth naked scape is nearly 2 feet long below the short laxly-flowered raceme (4–5 inches). The white scarious bracts are marked with 3–4 median reddish-brown converging veins, and are 4 lines long below, the upper ones shorter. The perianth-segments are suffused and veined with crimson and have a greenish or whitish scarious border; the three exterior are broadly lanceolate and 6½ lines long by 2 in breadth, with 7 nerves (two of which, however, only run to within a third of the tip); the interior are spathulate, with a narrower reddish centre and a broader hyaline margin than the outer three, which they equal in length or are slightly shorter, but are 3 lines broad. The stamens are all fertile. The filaments are 5 lines long and are constricted above the broad rounded base (1½ line long); the anthers are 2½ lines. The ovary is 2 lines long, the style 5 lines. The thin transparent capsule measures ½ inch long by ⅓ broad, and allows the several dead-black flattened seeds to be seen through the walls. The latter are ¼ inch long by 1¾ line broad.

Differs (e descriptione in Engler's Jahrb. xv. p. 472) from *A. Steudneri*, Schweinf. & Engl., from Kalabat, in having bracts only a little more than half the size, while the petals are more than twice as broad, with red (not green) nerves, and the seeds twice as large. *A. purpurascens*, Engl. (ib.), an allied plant, is described with a globose bulb crowned with the persistent fibrils of past leaves, a raceme 8 inches long, bracts nearly twice as long as in Taylor's plant, smaller narrower petals, and smaller fruits and seeds.

ORNITHOGALUM ECKLONI, *Schlecht. in Linnæa*, XXV. p. 177.

Kithungulu, Kikuyu Country, shrub-covered plateau with deep gorges: J. W. Gregory, July 11, 1893.

Distrib. South and Tropical Africa.

SCILLA (§ LEDEBOURIA) TAYLORIANA, sp. nov. Herba glabra; bulbi ovoidei squamis minute maculatis; foliis synanthiis tenuibus papyraceis late lanceolatis, apice acutis, basi in petiolum convolutum angustatis; scapo subrobusto terete cum racemo lineari-oblongo folia superante; bracteis scariosis minutis subulatis; pedicellis patentibus vel suberectis, inferioribus infra medium articulatis; floribus campanulatis; perianthii segmentis ligulatis basi in cupulam brevem connatis, apice papillosis, medio univittatis, inferne lilacino-purpureis sursum viridescentibus; staminibus perigynis perianthio brevioribus, filamentis velut stylo saturate purpureis; ovario viridi breviter stipitato, 3-dymo, lobis bicornulatis; stylo centrali filiformi; capsulæ lobis fertilibus a sutura interna dehiscentibus; seminibus solitariis magnis bruneis ovoideis apice cristatis.

Hab. Rabai Hills: W. E. Taylor, Sept. 1885.

A plant about 15 inches high, with a bulb about 1 inch thick, the membranous scales of which are finely dotted with white marks. The three produced leaves are extremely thin and papery, with a number (14 or more) of strongly-marked veins united by numerous thin transverse ones, the pointed broadly lanceolate blade is about 6 inches long by $1\frac{1}{4}$–$1\frac{2}{3}$ inch broad, tapering gradually to a petiole (about $2\frac{1}{2}$ inches long) which is convolute in the dried specimen. The scape, including the raceme, is 14–19 inches long, the raceme being 5–11 inches, and about $1\frac{1}{4}$ inch in breadth. The pedicels are $3\frac{1}{2}$ to 6 inches long; the upper longer ones tinged with lilac-purple, the lower green. The flowers are about 4 lines or a little more in length; the lower part of the perianth is lilac-purple in colour but passes into green above. The narrow segments are ligulate, slightly broader at the top, $3\frac{1}{2}$–4 lines long by $\frac{1}{2}$ line broad, and bear a tuft of short white hairs at their tips. The purple filiform filaments are $2\frac{1}{2}$ to 3 lines long; the small, shortly oblong yellow anthers $\frac{1}{2}$ line long. The shortly stalked ovary passes above its base into three lobes, each with a broad apex flanked by a pair of short horns; the purple style springs from the centre of the ovary between the lobes, and is 4 lines long. In the fruit one or two of the lobes abort; the fertile lobes dehisce on the side turned towards the style and expose the large brown crested seed $2\frac{1}{2}$ lines long by $1\frac{1}{4}$ broad.

Approaches *Scilla lilacina*, Baker, from Nubia, but is easily distinguished by its broader papery leaves passing more suddenly into a narrower petiole, its less dense raceme, and larger flowers.

SCILLA (§ LEDEBOURIA) TEXTILIS, sp. nov. Glabra; bulbo inter majores ovoideo, squamis firmis valde fibrosis; foliis firmis crassiusculis rubro-viridibus obovatis apice rigido acuminatis, basi submembranacea vaginante breviter angustatis, margine cuticulata undulatis, dorso a venis crebris parallelis lineatis; scapo flexuoso cum racemo cylindrico folia superante; bracteis minutis scariosis flaccidis lineari-subulatis; pedicellis patentibus inferioribus cernuis, medio articulatis; floribus breviter campanulatis viridulis; segmentis a basi latiore ligulatis, apice obtusis vix cucullatis, univittatis; staminibus perianthio brevioribus, filamentis lilacino-purpureis, subcompressis, antheris parvis oblongis; ovario breviter stipitato, lobis 6 in disco prominulente superpositis; capsulæ membranaceæ, loculis tribus cum semine solitario rotunde ovoideo nigro-bruneis.

Hab. Uyui: W. E. Taylor, Jan. 1887.

A plant 9 inches in height, the bulb $1\frac{1}{3}$ inch in diameter, with firm, rather thick, strongly-nerved scales, from which when cut or torn the nerves project as stringy fibres. The five or six leaves are broadly ovate above the narrower sheathed and sheathing base and pass suddenly above into the long narrow acuminate apex (broken in specimen); they are 3–$3\frac{1}{2}$ inches long and $1\frac{1}{2}$ inch broad in the middle, and have a minutely broken and wavy cuticularized margin and a large number of fine close-set parallel nerves. In colour they are green tinged with red. The single scape is flexuose below, including the raceme 7 inches in length; the fertile portion of the raceme is $2\frac{1}{2}$ inches by scarcely 1 in diameter. There are between 40 and 50 pedicels about $\frac{1}{4}$ inch in length and generally jointed somewhere near the middle; the upper ones are spreading, the lower cernuous. The narrow greenish perianth-segments are $2\frac{1}{3}$–$2\frac{1}{2}$ lines long and $\frac{1}{2}$–$\frac{2}{3}$ line broad, with a central darker green nerve; the lilac-purple filaments are $1\frac{1}{2}$ line long, the small yellow versatile anther $\frac{1}{4}$ line. The ovary is shortly stalked, with a slightly projecting basal disk bearing the upper portion, in which there are six external divisions; it is $\frac{3}{4}$ to 1 line long and bears a central style $1\frac{1}{2}$ line long. The membranous capsule splits into three 1-seeded pieces; the seeds are dark brown, ovoid or roundly ovoid in shape, and $1\frac{3}{4}$ line long.

Near the Cape and Tropical African *Scilla lanceæfolia*, Baker, but distinguished by its more ovate leaves, longer scape, and more slender less dense raceme.

SCILLA (§ LEDEBOURIA) UYUIENSIS, sp. nov. Herba glabra, parva; bulbo pro planta magno; foliis 2 oppositis crassiusculis ovatis apice obtusis in basin vaginantem subito angustatis; scapo erecto folia superante, a racemo brevi denso terminato; floribus sessilibus breviter campanulatis; petalis viridulis (?) basi in cupulam connatis, segmentis lineari-oblongis univittatis apice obtuso involutis; staminibus uniseriatis quam segmenta multo brevioribus; filamentis brevibus triangularibus; antheris didymis versatilibus; ovario rotundato, stylo erecto brevi.

Hab. Uyui: W. E. Taylor, Dec. 1886.

A small plant $3\frac{1}{2}$ inches above the rather large bulb, part of which is present in the specimen. The bulb is crowned by a pair of rather thick blunt ovate leaves suddenly narrowed at the base into a sheath about $\frac{1}{2}$ inch long, the blade being $1\frac{1}{2}$ inch long by 1 inch broad, with about 15 well-marked nerves. The scape measures nearly 3 inches below the short, very crowded, oblong terminal raceme $\frac{1}{2}$ inch long by $\frac{1}{3}$ broad. There are about 20 sessile, shortly campanulate flowers, the now greenish petals of which are connate at the base into a cup $\frac{3}{4}$ line long, the free narrow segments being $1\frac{1}{2}$ line long by $\frac{2}{3}$ line or a little more broad; the tip is rolled inwards, and there is a single central green line. The epipetalous stamens have very short, acutely triangular, now colourless filaments $\frac{1}{2}$ line long, bearing yellowish anthers $\frac{1}{3}$ line. The rounded ovary is sessile and without a disk, $\frac{1}{3}$ line long, and bears a short straight style $\frac{3}{5}$ line.

Near *S. somaliensis*, Baker, from Somaliland, but distinguished by the broader, blunter leaves, and the much shorter, very densely crowded raceme, the flowers of which are also smaller.

GLORIOSA VIRESCENS, *Lindl. in Bot. Mag.* t. 2539.

Rabai Hills, Kisulutini, Oct. 1885, and Buni, Sept. 1885: W. E. Taylor. Lanjoro, Athi plains, April 22, and Guaso Laschau, Laikipia plateau: J. W. Gregory, June 13, 1893.

Distrib. Tropical and South Africa.

GLORIOSA VIRESCENS, *Lindl.*, var. LATIFOLIA, var. nov. Varietas foliis ovatis, usque ad 9 lineas latis, apice acuto vel cirrhato.

Hab. Between Zanzibar and Uyui: W. E. Taylor, 1886.

A short plant with a stout stem and rather coarse semi-amplexicaul leaves, the lowest of which have an acute apex, while the higher are cirrhate. The flowers are rather small, with flat oblanceolate petals 1½–1¾ inch long by 4–5 lines broad.

WALLERIA MACKENZII, *J. Kirk, in Trans. Linn. Soc.* xxiv p. 497, t. 52. fig. 2.

Between Zanzibar and Uyui: W. E. Taylor, 1886.

Distrib. Tropical Africa.

WALLERIA NUTANS, *J. Kirk, ibid.* fig. 1 (W. Mackenzii, var. nutans, *Baker, Journ. Linn. Soc.* xvii. p. 499).

Uyui: W. E. Taylor, Feb. 1887.

Distrib. East Tropical Africa.

COMMELINACEÆ.

COMMELINA AFRICANA, *Linn. Sp. Pl.* p. 60.

Njoro Larabwal, foothills of Laikipia: J. W. Gregory, June 7, 1893.

Distrib. South and Tropical Africa; Bourbon.

COMMELINA *cf.* PURPUREA, *C. B. Clarke, MS. in Herb. Kew.*

Steppes between Ndoro and Guaso Thegu: J. W. Gregory, June 1893.

COMMELINA SUBULATA, *Roth, Nov. Sp.* p. 23.

Kinani, East Ongalea Mountains, 2200 ft.: J. W. Gregory, April 6, 1893.

Distrib. Tropical Africa and India.

COMMELINA ALBESCENS, *Hassk.*; *Schweinf. Æthiop.* p. 210.

Freretown: W. E. Taylor, Dec. 1885. Mkonumbi, near Witu: J. W. Gregory, Nov. 1892.

Distrib. Tropical Africa to India.

COMMELINA BAINESII, *C. B. Clarke*, var. GLABRATA, *Rendle, in Trans. Linn. Soc.* ser. 2, *Bot.* iv. p. 52.

Rabai: W. E. Taylor, Sept. 1885. Native name "Dzadza."

Distrib. *C. Bainesii* occurs from S. Africa to Angola, the variety in Nyasaland.

COMMELINA *cf.* FORSKALÆI, *Vahl.*
Freretown: W. E. Taylor, Dec. 1888. Native name "Dzadza."
Distrib. Tropical Africa, Arabia, and India.

ANEILEMA ÆQUINOCTIALE, *Kunth, Enum.* iv. p. 72.
Ravine near Fimboni, Rabai Hills, Aug., Oct., and Nov. 1885; Mochi, 4000 to 5000 ft., 1888: W. E. Taylor. Native name "Dzadza."
Distrib. Tropical Africa and Arabia.

ANEILEMA SINICUM, *Lindl. in Bot. Reg.* t. 659; char. emend. *C. B. Clarke, in Mon. Phan.* iii. p. 212.
Rabai Hills: W. E. Taylor, 1885 and 1886. Guaso Thegu and Kithungulu, Ukikuyu: J. W. Gregory, June and July, 1893.
Distrib. Tropical and South Africa to Tropical Asia and China.

ANEILEMA (§ LAMPRODITHYROS) CLARKEI, sp. nov. (Pl. XXXIV. figs. 7–12.) Caule glabro decumbente e nodis inferioribus radicante; foliis ovati-lanceolatis, junioribus ovalibus vel ovali-lanceolatis, conspicue pauci-venosis, in facie marginibusque hirsutulis, vaginis hirsutulis membranaceis ore barbatis; cymis axillaribus paucifloris; pedicellis minute pubescentibus; sepalis glabris, lateralibus rotunde ovoideis, dorsali vix breviore cucullato; petalis lateralibus longe unguiculatis limbo late patente, anteriore lato basi angustato; staminibus fertilibus 3 (?) filamentis longis, sterilibus 3 brevioribus (quorum posteriore minimo), aurantiaceis; stylo longissimo filiformi e flore longe curvato, ovario 3-quetro a pilis brevibus pluri-cellulis glandulosis (?) induto, loculis 3, quorum dorsali uni-, anterioribus 2-ovulatis; capsula apice rotundata puberula, loculis 3, dorsali monospermo quam anteriores 2-spermi minori; seminibus lapidosis irregulariter cordatis, latere maximo rotundato et foveolato, aliis 2 complanatis levibus et in medio alte sulcatis.

Hab. Lake Dumi, Tana: J. W. Gregory, Feb. 13, 1893.

The creeping stems a foot or more in length ascend in the upper portion. The leaves on the main axis have a membranous whitish sheath $\frac{1}{3}$ inch long, and a blade $1\frac{1}{4}$ inch long, by less than $\frac{1}{2}$ inch broad above the base; on the young lateral shoots they are shorter, blunter, and more oval in shape. The axillary cymes are 3-flowered. The roundly ovoid lateral sepals are $1\frac{1}{2}$ line long by $1\frac{1}{4}$ broad, the dorsal slightly shorter and hooded;

the delicate lateral petals are long clawed, with a broad finely-veined spreading limb, the anterior one (3 lines long) is also broad and similar in texture with a narrow base; the petals in the specimen were all more or less marcescent. The three staminodes are orange-coloured, the anthers represented by flat bilobed appendages; the dorsal one is much reduced in size. The subtriquetous ovary is 3-celled and densely covered with short few-celled hairs apparently glandular; the very long, curving style protrudes from the flower. The somewhat roundly ovoid capsule is scarcely 2 lines long by 1½ broad; the dorsal chamber is smaller than the other two and contains only one seed, the others being two-seeded. The seeds are stony, light brown in colour, and irregularly 3-lobed or almost cordate in shape; the large rounded surface bearing the hilum is foveolate, the other two are smooth with a deep median furrow; they measure ⅔–¾ line in length.

Forms a distinct species of the section *Lamprodithyros*. The material is rather poor and badly dried, but as Mr. C. B. Clarke, who was kind enough to give me an opinion on the plant, agreed that it was decidedly new, I have ventured to describe it, acknowledging my debt in the specific name.

CYANOTIS HIRSUTA, *Fisch. et Mey. Ind. Sem. Hort. Petrop.* 1841, p. 57.

Uyui: W. E. Taylor, Feb. 1887.

Distrib. Abyssinia.

CYANOTIS LANATA, *Benth. in Hook. Niger Fl.* p. 542.

Giryama and Shimba Hills: W. E. Taylor, 1887.

Distrib. Tropical Africa.

JUNCACEÆ.

JUNCUS EFFUSUS, *Linn. Sp. Plant.* p. 326.

Mt. Kenya, 8100 ft., lower forest zone: J. W. Gregory, June 1893.

Distrib. Widely spread in temperate zone.

JUNCUS FONTANESII, *J. Gay, ex Laharpe in Mém. Soc. Hist. Nat. Par.* iii. p. 130.

Steppes between Ndoro and Guaso Thegu, Ukikuyu country: J. W. Gregory, July 7, 1893.

Distrib. Mediterranean region and Persia; Abyssinia.

LUZULA SPICATA, *DC.*, var. SIMENSIS, *Hochst. in Herb.*

Mt. Kenya, 8100 ft., lower edge of Bamboo zone: J. W. Gregory, July 24, 1823.

A more robust plant, but apparently the same variety, was collected by Taylor in 1888 on the higher slopes of Mt. Kilimanjaro up to 10,000 ft.

Distrib. of variety. Abyssinia, "in montibus simensibus ad 11,000 ped."

FLAGELLARIACEÆ.

FLAGELLARIA INDICA, *Linn. Sp. Pl.* p. 333.

Rabai: W. E. Taylor, Sept. 1885. Leaves only.

Distrib. Tropical and subtropical parts of Old World.

PANDANEÆ.

PANDANUS RABAIENSIS, sp. nov. (Pl. XXXIV. figs. 1–6.) Folio longo lineari sursum angustato apice valde elongato, glauco coriaceo, in margine et costa media carinata aculeato, aculeis crebris ascendentibus apice flagelliformi minoribus et densioribus; inflorescentia ♂ paniculata, staminibus singulis in ramulis ultimis spiciforme ordinatis; filamentis brevibus teretibus subrobustis; antheris linearibus, post anthesin spiraliter contortis, connectivo supra loculos valde apiculato; drupis solitariis, 1–5- sæpius 4-loculis, obconicis, apice libero (totius parte quarta vel tertia) rotundato, inferne 5–6-angulis, stigmatibus 1–5 in areola centrali depressa sæpe insitis vel ab eâ circumdatis, fructu planis; mesocarpio fibroso, endocarpio crasso lignoso loculis utrinque circumdato et processus in parte superiore emittente.

Hab. Kisulutini, Rabai Hills: W. E. Taylor, 1886. Native name "Mtsapu."

The only leaf sent is 5½ feet long and 2¾ inches broad above the base where it has been cut off; it tapers gradually upwards and the long drawn-out apex forms a flagellum. The margin and midrib, the latter deeply keeled on the back, are strongly spinescent; the spines, which are scarcely darker than the yellowish upper leaf-surface, are ascending; in the lower portion there are 30 to the foot, each about a line long, above they become gradually more crowded and finer, and in the flagellum are very small, sharp, and dense. The stamens are quite free from each other, and arranged in a spicate manner on the ultimate branches (about ½ inch long) of the panicle. The filaments are short and firm, ⅔ line long or less in the upper part of each spike, and bear a long (nearly 2½ lines) linear anther, the connective of which is prolonged into a short pointed sometimes recurving tip. The obconical separate drupes are 1¼–1½ inch long, ¾–1 inch broad above, the upper third or quarter free, smooth, and shortly rounded, with more or less indication of the angles, 5–6 in number, exhibited on the lower compressed fibrous portion. The flattened, generally oval stigmatic scars, varying from 1–5 in number, mostly 4, surround or are seated in a central depressed area. The mesocarp is coarsely fibrous and spongy, and passes rapidly into the hard woody endocarp, which surrounds the clavately oblong seed-chambers, and sends conical processes into the thicker spongy upper portion of the mesocarp.

Approaches the Madagascar species *Pandanus utilis*, Bory, in fruit characters, but is separated by the spicate, not umbellate arrangement of the stamens, in which it approaches *P. fragrans*, Brongn., from New Caledonia, as figured in Ann. Sci. Nat. sér. 6, i. t. 15, and reproduced without acknowledgment by Solms Laubach in his review of the family in Engler and Prantl's 'Pflanzenfamilien' [II. Theil, 1 Abth. fig. 147 (p. 188)]. The upper part of the fruit is also shorter and the leaf-spines are rather larger and not reddened.

The spicate arrangement of the stamens separates our plant from all the known African, Malagasy, and Mascarene species.

TYPHACEÆ.

TYPHA ANGUSTIFOLIA, *Linn. Sp. Plant.* p. 971.

East side of Lake Losuguta, 5000 ft., Naivasha, and Baringo Valley: J. W. Gregory, May 16, 1893.

Distrib. Temperate to tropical regions of northern hemisphere.

ALISMACEÆ.

ALISMA PLANTAGO, *Linn. Sp. Plant.* i. p. 342.

Guaso Nairotia, 6720 ft., Laikipia plateau: J. W. Gregory, June 15, 1893.

Distrib. Arctic, North temperate regions, and mountains of Tropics (Himalaya); Australia.

NAIADACEÆ.

APONOGETON ABYSSINICUM, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. p. 351.

Second Swamp, Kikuyu, 6780 ft.: J. W. Gregory, April 28, 1893.

Distrib. Probably generally distributed in Tropical Africa, as besides the original Abyssinian specimen we have specimens from Kitui in Ukamba (*Hildebrandt*) and from West Africa from Pungo Andongo (*Welwitsch*).

NAIAS GRAMINEA, *Del. Fl. Egypt.* p. 282.

Kinani, East Ongalea Mts., 2200 feet: J. W. Gregory, April 6, 1893.

Distrib. Tropical Asia to Egypt.

CONIFERÆ.

PODOCARPUS aff. MANNII, *Hook. f. in Journ. Linn. Soc.* vii. p. 218.

Middle of Bamboo zone, Mt. Kenya, 8000–9000 feet. Dense forest, trees 80–100 ft. high: J. W. Gregory, June 25, 1893.

The leaves reach half a foot in length and ½ an inch in breadth and are therefore larger than in *P. Mannii.* The plant closely resembles a specimen in the British Museum from the Cape collected by Capt. Waldegrave and named *Taxus falcata*, Thunb. There is, however, considerable confusion as to what is *Podocarpus falcata*, and until this is cleared up it is inadvisable to describe a new species from a doubtful specimen. *P. Mannii* was collected by Gustav Mann on the island of St. Thomé at a height of 7500 ft.

EXPLANATION OF THE PLATES.

PLATE XXXI.

Lagarosiphon tenuis, sp. nov.

Fig. 1. Shoot, nat. size.
2. Leaf of same, ×10.
3. Leaf-teeth of same, highly magnified.
4. Leaf-tooth of *L. nyassæ*, Ridley, highly magnified.
5. Upper part of ♀ flower of *L. tenuis*, × 10.
6. Petal of same, × 16.
7. ♀ spathe enclosing base of flower.

Lagarosiphon crispus, sp. nov.

Fig. 8. Shoot, nat. size.
9. Leaf, × 8.
10. Leaf-teeth, highly magnified.
11. ♂ spathe enclosing unopened flowers, × 10.
12. Stamen, much enlarged.
13. ♀ spathe enclosing base of flower, × 17.

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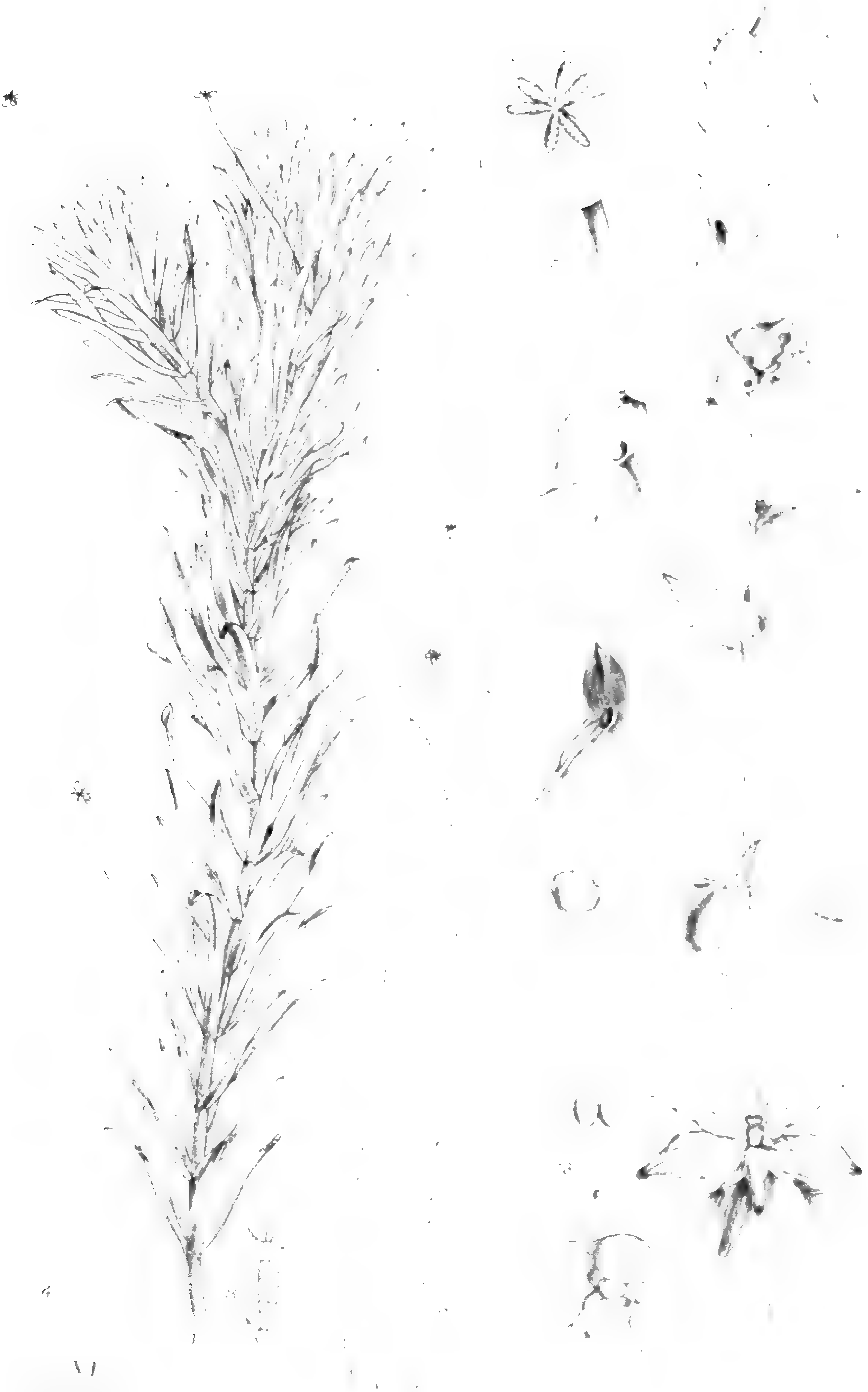
R. Morgan del. et lith. West, Newman imp.

1-7, LAGAROSIPHON TENUIS, *Rendle.*
8-17, „ CRISPUS, „

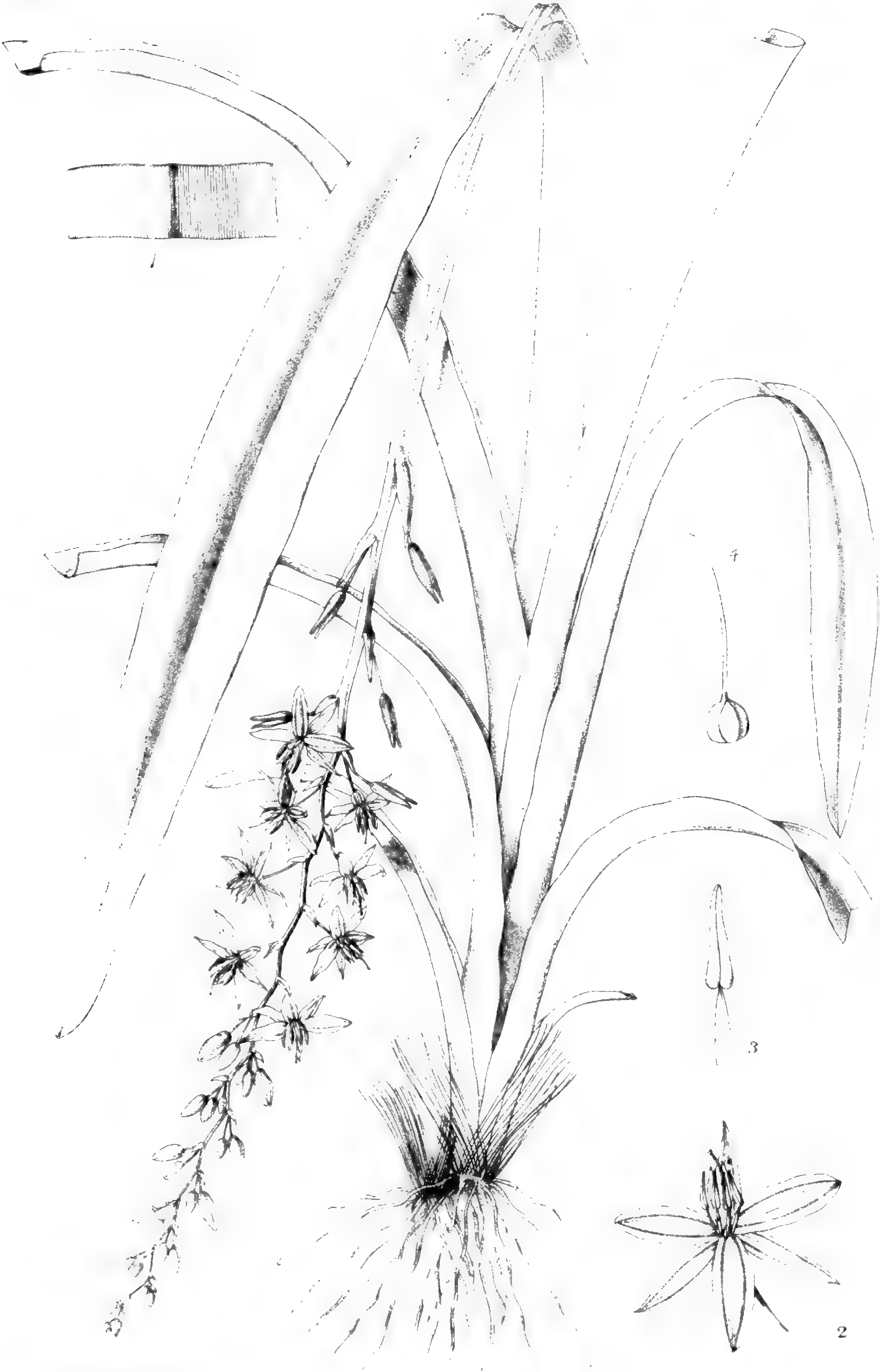


M. [illegible] del et lith.

[illegible]

Rendle.

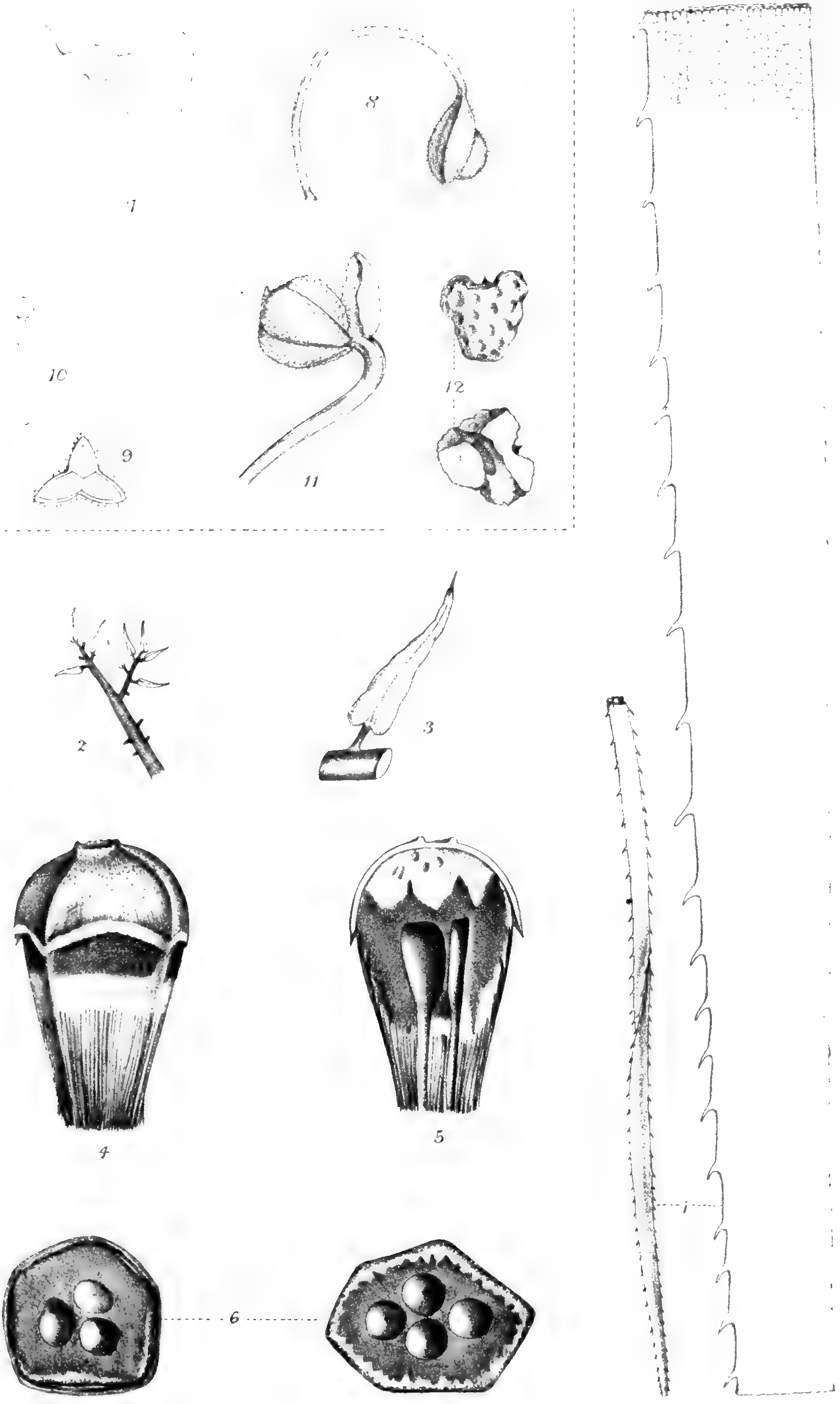
Linn. Soc. Journ. Bot. Vol. XXX. Pl. 36.



M. [illegible] et lith.

West, Newman imp.

ANTHERICUM SPECIOSUM, *Rendle.*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R. Morgan del. et lith.

West, Newman imp.

1-6. PANDANUS RABAIENSIS, *Rendle.*
7-12. ANEILEMA CLARKEI, *Rendle.*

Fig. 14. The same, more advanced, × 17.
15. Fruit, × 6.
16. Do. in longit. sect.
17. Ovule, much enlarged.

PLATE XXXII.

Lagarosiphon hydrilloides, sp. nov.

Fig. 1. Shoot, nat. size.
2. Leaf, × 4.
3. Leaf-teeth, strongly magnified.
4. Stipule, × 25.
5. Upper part of ♀ flower, enlarged.
6. ♀ spathe enclosing base of flower, × 5.
7. Ovule, much enlarged.

Disperis kilimanjarica, sp. nov.

Fig. 8. Plant, nat. size.
9. Anterior sepal, × 3.
10. End of labellum, × 5.

Angræcum fimbriatum, sp. nov.

Fig. 11. Flower, × 2.
12. Column and anther, × 6.
13. Pollinia, × 6.

PLATE XXXIII.

Anthericum speciosum, sp. nov. Plant, half nat. size.

Fig. 1. Portion of leaf to show veining, nat. size.
2. Flower, nat. size.
3. Stamen, × 2.
4. Ovary, × 2.

PLATE XXXIV.

Pandanus rabaiensis, sp. nov.

Fig. 1. Margin and apex of leaf, nat. size.
2. Small portion of ♂ inflorescence, × 2.
3. Stamen, × 6.
4. Fruit, nat. size.
5. Do. in longit. sect.
6. Do. in transv. sect., from two specimens, showing trilocular and quadrilocular arrangement.

Aneilema Clarkei, sp. nov.

Fig. 7. Upper part of staminode, magnified.
8. Ovary after fertilization, magnified.
9. Transv. sect. of do.
10. Hair from ovary-wall, magnified.
11. Capsule before dehiscence, × 3.
12. Seed viewed from before and behind, × 7.

On the Origin of the Filamentous Thallus of *Dumontia filiformis*. By George Brebner, late Marshall Scholar in Biological Research, Royal College of Science, London. (Communicated by George M. Murray, F.L.S.)

[Read 1st March, 1894.]

(Plates XXXV. & XXXVI.)

A Government Grant was sanctioned by the Royal Society to enable the writer of the present paper to study the life-history of certain genera of marine algæ. While these investigations were being pursued in the Clyde sea-area, an algal incrustation was noticed growing on *Fucus serratus* gathered at the Little Cumbrae, on the 30th November, 1892. Its colour was a very dark ruddy brown, almost like that of *Petrocelis cruenta*. This incrustation was very variable in size and shape, attaining a diameter of 1·5 cm. to 2·5 cm., and was frequently found extending round from one surface of the host to the other without interruption. The first sections made showed the appearances presented in fig. 1; and the peculiar conceptacle-like conformation at *a* was specially noticed. The supposed conceptacle did not agree with any of those which are well known, and the incrustation was taken to be the imperfectly known *Hæmatocelis fissurata*, Crouan. Indeed it is somewhat difficult to believe the two things distinct after careful comparison of suitable preparations with the figure in the 'Florule du Finistère'[*].

A considerable number of sections were made from the fresh material, mounted in Dean's medium, and laid aside pending further observations. It was not till March 1893 that the matter was cleared up, when this structure was found to be the attaching disk of *Dumontia filiformis*. The fact that this alga grows from a perennial "basal disc" was published by J. Reinke in 1889[†]. He says:—"The upright fruiting thallus arises from a basal disc which rests on the substratum. This disc is composed of closely packed vertical rows of cells, and resembles a *Hildenbrandtia*. Whereas the upright thallus dies down after the spores are shed, the basal disc is perennial and can put forth new thalli." As far as could be ascertained, these are the only published observations on the relation of the ordinary thallus of *D. filiformis* to its "basal disc."

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[*] Ibid. pl. xix. fig. 127.

[†] J. Reinke, 'Algenflora der westlichen Ostsee,' Kiel, 1889.

The mode of origin of the upright thallus from the creeping one seems of sufficient interest to warrant a somewhat detailed description. The creeping thallus is composed of more or less vertical closely-set rows of cells bound together by the cohesion of their gelatinous walls (*cf.* figs. 1 & 2, Pl. XXXV.; figs. 5 & 7, Pl. XXXVI.). The individual articulations* or cells are connected end-to-end by the characteristic Floridean pits. When branching takes place, it does so by means of the formation of two successive oblique divisions at the tip of the terminal cell of the row. An illustration of this is given in fig. 3, A, *s.d.*; and when the process is complete, the branches are found to be connected by the characteristic pits to the parent cell, having the arrangement shown in figs. 3 A and 4 B, *br.* The branches are very nearly, sometimes quite, equal, and the septation which gives rise to them must follow in very quick succession, and might even be simultaneous. The term *subdichotomous* might very well be adopted for this kind of branching. It is not a true dichotomy of the terminal cell, for only portions of it are cut off at the tip by oblique septa instead of the branches being formed by a median longitudinal wall.

The filaments of the creeping thallus increase in length by the transverse division of their terminal cell; and there is no sign of subsequent intercalary division of the cells except in certain special cases which will be subsequently described. As the articulations are connected with each other by pits in the longitudinal direction only, it is evident that the ultimate ramifications can be but very remotely connected one with another. Only one or two cases could be found in which an articulation had divided parallel to the long axis in order to give rise to a branch; but even then it was not divided by an organically median longitudinal wall. This is of importance in relation to Fr. Schmitz's views on the structure of the Floridean thallus. They were explained in his 'Untersuchungen ueber die Befruchting der Florideen'†, and subsequently upheld with but slight modification in his "Kleinere Beiträge zur Kenntniss der Florideen"‡. The following is Fr. Schmitz's summary of his results:—"The thallus of the Florideæ, in general, is built up of a branched system of articulated filaments (*Zellfäden*). These filaments grow in length by the progressive acropetal division of the terminal cell, but transverse divisions do not occur in the articulations (*Gliederzellen*), nor longitudinal ones which are axially median." The structure of the creeping thallus of *D. filiformis*, as described above, agrees very well with these views.

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* This term, though not a happy one, will frequently be used in this paper as the equivalent of cell, since it is generally employed in that sense by algologists.

† Berlin, 1893, p. 4 *et seq.*

‡ 'La Nuova Notarisia,' serie 3, 1892, p. 111 *et seq.*

Passing on to the consideration of the mode of origin of the ordinary *Dumontia* thallus, fig. 1 represents at *a* an early stage in the formation of the upright thallus. This more or less conical mass of filaments differs considerably in appearance from the surrounding tissue, chiefly owing to the individual members having a far greater number of transverse divisions than are found in the ordinary filaments of the creeping thallus. The appearances represented in this figure show the commoner mode of origin, which will be termed *endogenous* on account of the deep-seated position of the active filaments.

In other cases the aggregations of very short-celled filaments are not infrequently found with their ends at the free surface: hence this may appropriately be termed the *exogenous* mode of origin (fig. 2, *a*). It is obvious that these specialized groups of filaments have arisen by the local transverse septation of the articulations. A careful study of the various stages shows that generally a few of the cells of a filament become transversely divided into two some distance from the upper end (fig. 4 A, *a′*), or just at the top (fig. 2, *x*, and fig. 3 B), the terminal cell in the latter case likewise dividing. As a result, a more or less moniliform row is formed, which is seen fairly well in the filament *x* of fig. 2. Each of the short cells of the moniliform portion of the filament divides again (fig. 3 C, *a′*). Other divisions quickly follow until a part of the filament becomes converted into a considerable number, frequently twenty-four, of thin discoid cells (fig. 4 B, *a′*). Comparison of a large number of groups in various stages of development leave but little doubt that these thin cells increase in number by the division of what may be called the apical cell of the specialized row.

In the case of endogenous origin, which is most frequent, the filaments obviously must divide in an intercalary manner (*i. e.* so that several articulations at the distal end take no part in the new formation), the outermost cell of those which do thus divide becomes pointed and converted into an apical cell (fig. 4, *ap.c'*). The distal non-active part of the row loses connexion with the parent filament after the differentiation of the discoid cells in the latter (fig. 1, *b*). What exactly happens to these dissociated portions of filaments was not made clear by the preparations. The growing endogenous group of filaments certainly makes its way to the surface; but whether this is simply due to a mechanical forcing, or is effected by the aid of a digestive process, analogous to that by means of which lateral roots in higher plants penetrate the cortex, will have to be left for further investigations to decide. These fragments probably disappear, and are not simply displaced, as at a later stage the protruding group is seen to be cleanly and sharply marked off from the adjacent somewhat compressed filaments of the creeping thallus. The walls of these fragments evidently become very mucilaginous. This might very well be due to a enzyme secreted by the specialized filaments. That enzymes, under certain conditions, play a very important part in the solution of cell-walls has been demonstrated by Prof. Marshall Ward* in the case of fungal hyphæ. Prof. Reynolds Green also has added considerably to our knowledge of the solvent action of enzymes in his work on the germination of the pollen-grain†.

The central filaments of the group, whether immersed or superficial, first begin to elongate. Indeed the development of the whole group, be it endogenous or exogenous, is centrifugal. This can be realized to a certain extent by inspection of fig. 2, where the peripheral filaments are seen to be in a less advanced stage of septation than the more central ones. The elongation of the specialized filaments is due to the growth in length of the discoid cells, which at the same time increase very much in diameter. The conical appearance seen in fig. 1 *a* may become, in consequence of this, very much accentuated. A section showing the earliest stage of protrusion has not been figured, but the appearance of the annual thallus, in surface-view, soon after it has made its way out, is shown at *a* in fig. 5. Sections, optical or other, of this club-shaped mass show that the articulations of the central filaments have become very long, and thus give rise to the loose internal tissue of the filiform thallus. The peripheral rows of discoid cells, and such portions of the more central ones as reach the surface, divide up, in the first instance as seen in fig. 4 C, and by subsequent repeated (sub-dichotomous?) branching give rise to the well-known candelabra (*Armleuchter*) arrangement of the periphery of the mature filiform thallus, as seen in transverse or longitudinal section. There is some reason for believing, from certain appearances in the growth of fig. 5, that the apical cells which carry on the growth of the annual thallus and its branches are simply developed from specially favoured apical cells of the specialized filaments. This club-shaped structure acquires additional interest from v. Zeller's remarks on the exotic *Dumontia fastigiata* *. This alga it seems is found in three different forms which are so distinct that, if their specific identity had not been proved, they would not be recognizable as the same plant. At the meeting reported, v. Zeller exhibited three specimens: the 1st was a simple club-shaped utricle, indented at the top; the 2nd was a dichotomously-branched, hollow, slippery, friable mass, adhering firmly to paper on drying; the 3rd was firm, cylindrical, and copiously branched. It is the first of these which is the most interesting from the point of view of the present investigation, and is probably comparable to the club-shaped mass of fig. 5, only much longer persistent.

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* Marshall Ward, "A Lily Disease." Ann. Bot. 1888, p. 337 *et seq.*

† Reynolds Green, "Researches on the Germination of the Pollen-grain and the Nutrition of the Pollen-tube." Phil. Trans. vol. 185 B, 1894.

That the stages described above are truly young conditions of the *D. filiformis* of algologists is shown by the low-power fig. 6 and by fig. 7. The former shows an easily recognizable *Dumontia* annual thallus, *a*, growing from the perennial creeping thallus, *cr.th.* The latter illustrates a more highly magnified base of a still older filiform thallus showing the relation to the attaching "disc." The medullary portion of the former is seen to be composed of greatly elongated articulations which have arisen from the more central filaments of the original group. Likewise, as far as the magnification would allow, the branching of the peripheral filaments is shown, as also of more internal ones which, by their more rapid growth, have become superficial during part of their course.

It may be worth while to note here that the origin of the upright thallus from its attaching base is totally at variance with

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* "Ueber vielgestaltige Algen." Württemb. naturwissen. Jahr esberichte, 1876, p. 90.

Fr. Schmitz's views on the structure and development of the Floridean thallus, as quoted above, for it has arisen *entirely* (taking the typical endogenous mode of origin) by intercalary division of the articulations ("Quertheilungen der einzelnen Gliederzellen") of the filaments. It is somewhat doubtful whether his generalization could legitimately be expected to include such an exceptional case, the first of its kind published, so far as could be ascertained. On the other hand, the subsequent development of the filiform thallus agrees in essential points, so far as was observed, with his generalization: that is, this thallus and its branches grow in length by the transverse acropetal division of an apical cell, and the segments cut off from the same do not divide by an axially median longtuidinal wall, nor in an intercalary manner.

The creeping thallus, when found growing on other algæ, instead of the more usual rocky substratum, is attached to its host by more or less conical plugs of tissue, which penetrate the latter and destroy its cells, as they work their way in. Nothing in the shape of haustoria could be observed, but the appearances are distinctly suggestive of parasitism, if serious local damage to the host is any indication. The outermost small-celled layer has frequently disappeared, and the young plug, or branch from an older one, is clearly seen penetrating between the individual cells of the host, the contents of which show large morbid granules, or oily-looking drops, accompanied by general disorganization, whilst walls in all stages of breaking down (absorption?) are frequent. Here again the question of the *modus operandi* has to be considered. In this case there is a much stronger suggestion of enzymic action than in the outward passage of the endogenously developed filiform thallus. All the appearances in the neighbourhood of these organs of attachment are suggestive of the secretion of some solvent medium by the cells of the penetrating branches. Moreover, it is more probable that in this case there is a nutritive digestion, as the innermost articulations of the creeping thallus lose their pigment as the thallus increases in thickness and thus cease to be self-sustaining, so to speak, and become either entirely dependent on the more superficial assimilating articulations, or partially on these and partially on the host. It is quite possible, however, that these plugs serve simply as hold-fasts, and that their disintegrating power is correlated to that function only. The above observations suggest a profitable field of investigation, viz. the secretion of enzymes by marine plants.

It is also interesting to note how the basal thallus by localized vigorous growth creeps over itself, as it were, and becomes several layers thick (fig. 1, *cr.th.*). When the annual thallus dies down, its base, which is immersed in the perennial part, persists and is subsequently imbedded by the overlapping of the latter (fig. 1, *c*). The immersed portion is frequently not developed peripherally in the candelabra-like manner of the free part, but in one or two cases sections show the former having precisely the same structure as the latter.

M. Möbius has figured the relation of the exotic little *Amphiroa* (*brasiliana*?) to its attaching disc *, but as the upright thallus is evidently not developed in any way analogous to the case just considered, it does not require more than passing mention here.

In September 1893 the writer learnt from Prof. Harvey Gibson, of Liverpool, that he had found the "basal discs" of *Dumontia filiformis* growing on *Laminaria hyperborea*, and that he had traced the most important points in the origin of the ordinary thallus from the "basal disc" as early as 1889. As Prof. Gibson had not yet published his observations, although intending to do so sooner or later, he courteously waived his claim to priority on learning that the present paper, based on entirely independent observations, was in progress.

Summary.

(1) *D. filiformis* has a creeping basal thallus by which it adheres to the substratum.

(2) The creeping thallus is perennial and, when epiphytic (parasitic?), is attached to its host by plugs of tissue which cause marked disintegration of the cells of the host.

(3) The ordinary filiform thallus owes its origin to the intercalary transverse septation of the articulations of certain branches of the creeping thallus. The group of active filaments may be endogenous or exogenous, and the order in which the rows of cells become specialized is generally centrifugal, *i.e.* certain filaments begin to divide in an intercalary manner and the adjoining filaments follow suit, the most recently divided being most peripheral.

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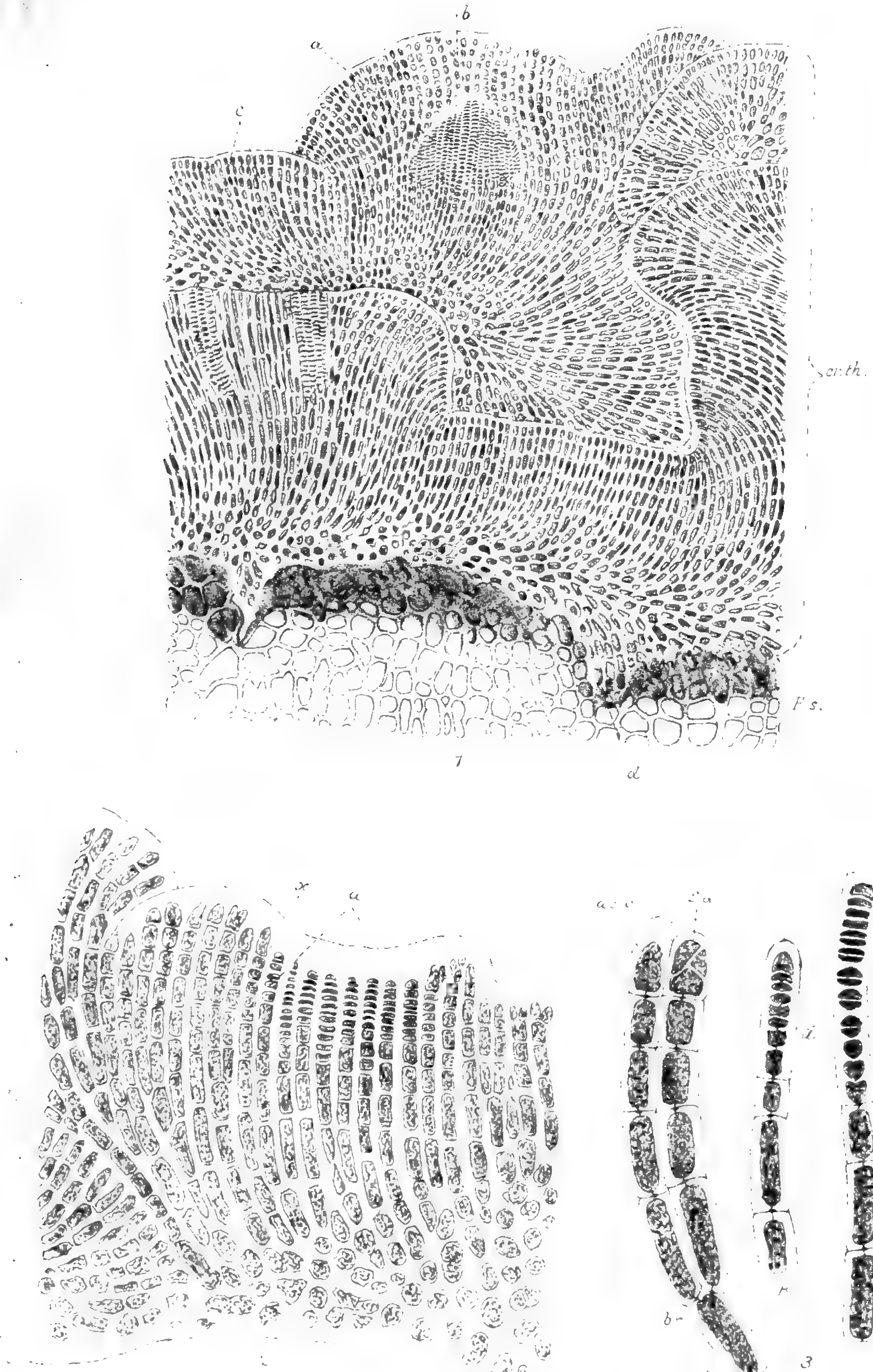
* 'Hedwigia,' 1889, Taf. xi. figs. 15 and 16.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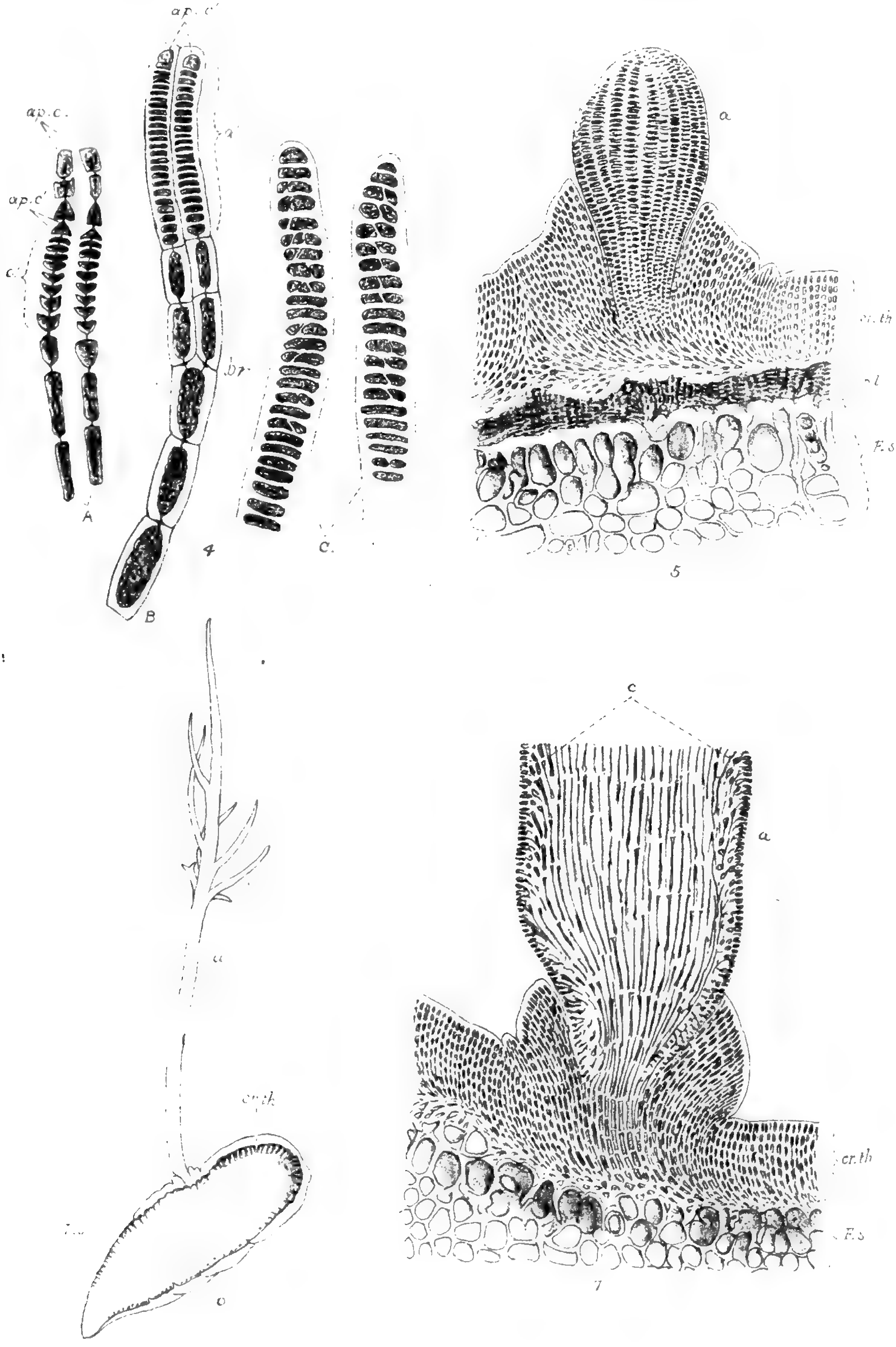
G.B. del. J.N. Fitch lith.

FILAMENTOUS THALLUS OF
DUMONTIA FILIFORMIS.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J.N.Fitch lith.

FILAMENTOUS THALLUS OF
DUMONTIA FILIFORMIS.

(4) These specialized outgrowths emerge from the creeping thallus—remaining attached to it by their basal portion—and by the subsequent growth and division of the constituent filaments give rise to the annual, well-known *Dumontia filiformis* thallus.

EXPLANATION OF THE PLATES.

Plate XXXV.

Dumontia filiformis.

Fig. 1. Creeping thallus, *cr.th.*, in vertical sect. An early stage in the development of the annual thallus is shown at *a*. The detached and disorganizing articulations of the parent filaments are seen at *b*. *c*, persistent base of annual thallus; *d*, attaching plug of tissue; *F.s.* *Fucus serratus*, trans. sect. × 100.

2. Portion of creeping thallus illustrating exogenous mode of origin of the annual thallus. *a*, specialized rows of cells; *x*, a filament in very early stage of septation. × 300.

3. A. Ordinary filaments of creeping thallus; *s.d.*, commencement of branching. B. A filament from an exogenous group showing early stage of septation. C. Another filament showing the next stage of septation to the preceding.

Plate XXXVI.

Fig. 4. A. Two filaments dividing in an intercalary manner at *a′* with secondary apical cells *ap.c′.*; *ap.c.*, terminal, or apical, cell of the ordinary creeping thallus filament; protoplasts only figured. B. Two specialized filaments from endogenous group *a* of fig. 1; therefore their apical cells, *ap.c′.*, are secondary; *br.*, point where the specialized filaments branched from an older one. C. Upper portion of two specialized filaments that have begun to elongate and of which the discoid cells have just begun to divide. × 450.

5. Protruding group of specialized filaments, *a*. *p.l.*, layer of a parasite between the basal disc, *cr.th.*, and the host, *F.s.* × 100.

6. Young annual thallus, *a*, showing relation to disc, *cr.th.*, and host, *F.s.* × 6.

7. Lower portion of an annual thallus, *a*, in long. sect., showing details of relation to the perennial creeping thallus, *cr.th.*; *c*, medullary filaments. × 100.

On the Mucilage-Canals of the *Marattiaceæ*. By GEORGE BREBNER, late Marshall Scholar in Biological Research, Royal College of Science, London. (Communicated by D. H. SCOTT, M.A., Ph.D., F.L.S.)

[Read 15th March, 1894.]

(PLATE XXXVII.)

DURING the course of an investigation of the comparative anatomy of the frond in the *Marattiaceæ*—the results of which are yet to be published—the mucilage-canals were seen to be well developed and, from their prominence in all the species examined, attracted special attention. Consultation of the literature revealed that, according to the most recently published work on the subject, these canals were considered to be *lysigenous* in origin—that is to say, the secretion was believed to be produced at the expense of the original protoplasmic body of certain early specialized cells, the cavity arising by the subsequent solution of their walls. R. Kühn, in his valuable contribution to the anatomy of the *Marattiaceæ* etc.*, came to that conclusion †, and his results appear to have been generally accepted, as they seemed to be conclusive for the cases examined by him. They were obtained from an examination of the roots of *Kaulfussia*, *Angiopteris*, and *Marattia*. Previous observers ‡ had given varying accounts of the development, some considering the canals to be *schizogenous*—*i. e.* resulting from the separation of the walls of special meristematic groups of cells at or near the centre of the group; the meristematic cells themselves being differentiated as a secretory epithelium—others holding them to be *lysigenous* in origin; but no very thorough examination seems to have been made in this group of plants previous to Kühn's work.

The adult condition of the canals in the frond of all the species of the four genera which were examined was so suggestive of their being schizogenous intercellular spaces with a secretory epithelium, that a re-investigation was deemed advisable. The material available was an entire young plant of *Angiopteris evecta* (var. *hypoleuca*?) besides large aerial and other roots of the type form, roots of *A. evecta* var. *pruinosa*, roots of *Marattia attenuata*, a young pinnule of *M. cicutæfolia*, and an entire young frond of *M. alata*. All but the last-named—which was kindly supplied by Prof. F. W. Oliver—were from the Royal Gardens, Kew.

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* "Untersuchungen über die Anatomie der Marattiaceen und anderer Gefässkryptogamen," Flora, 1889.

† *Loc. cit.* p. 481.

‡ H. Karsten, "Die Vegetationsorgane der Palmen," Schriften der königlichen Akademie der Wissenschaften, 1847, p. 132. Vriese et Harting, 'Monographie des Marattiacées,' 1853, p. 52. Wigand, "Ueber die Desorganisation der Pflanzenzelle etc.," Jahrb. für wissensch. Bot., Bd. iii. 1863, p. 150. Frank, "Ueber die anatomische Bedeutung der Entstehung der vegetabilischen Schleime," Jahrb. für wissensch. Bot., Bd. v. 1866–1867, p. 183. Russow, 'Vergleichende Untersuchungen,' 1872, p. 106 *et seq.* De Bary, 'Comparative Anatomy of the Phanerogams and Ferns,' Engl. Ed., 1884, p. 204.

The mode of origin of the mucilage-canals was found to be *typically* schizogenous except in the case of the roots of *A. evecta* var. *pruinosa*, which presented such peculiar features as to require special consideration after the more common mode of development has been dealt with.

The most successful preparations of very early stages were obtained from the petiole of a very young frond of *A. evecta*. This frond was about 4 mm. in diameter at the base and 2 mm. in the region from which figures 1 to 6 inclusive were obtained. The vascular bundles were already well differentiated as distinct groups, and in the larger ones the walls of the protoxylem elements were already thickened, but that was all. In these sections certain cells of the ground-parenchyma are seen to have become meristematic, giving rise to little specialized groups of cells (Pl. XXXVII. figs. 1, 2, 3 *a*). The constituent members of each group are smaller than the surrounding cells of the ground-tissue, the difference becoming more marked as the respective elements approach their adult condition. The four specialized cells in fig. 1 *a*, representing a very early stage of development, are not so markedly smaller than the surrounding cells, firstly because the ground parenchyma is still very young, and secondly because the cells of the meristematic group divide again without subsequently increasing much in size. In *Angiopteris* the meristematic group is composed of from four to ten or more elements; this is due to the fact that what may be called the canal initials are not constantly formed by the meristematic division of one cell only. In these, moreover, the divisions are by no means always radial to the centre of the future canal, and it is owing to that fact that the mature epithelium is not infrequently locally more than one cell thick. The canal initials are readily recognized at a very early period in their development, owing to their abundant granular protoplasm with the nuclei near the common point of contact of the cells; *cf.* figs. 1, 2, 3, at *a*. After the appearance of the schizogenous space their relatively small size would be alone sufficient to distinguish them, but they are still characterized by the abundance of their protoplasm and relatively large and conspicuous nuclei, although the latter no longer occupy the eccentric position of the earlier stages. Figs. 4, 5, and 6 show early stages in the development of the split, which takes place at or near the centre of the group. It is quite likely that in fig. 4 the split took place at the point of contact of four cells (*i. e.* as seen in transverse section), and that subsequently radial divisions took place in the young epithelium. It is not at all uncommon, where the original meristematic group was composed of a large number of cells, to find two spaces separated by one or more of the cells (fig. 6, *br.c.*). As the schizogenous space widens, the surrounding cells continue to divide by walls radial to the centre of the canal, and thus constitute a continuous small-celled epithelium. Divisions in the epithelial cells other than radial seem to be very exceptional except when the canal is still quite young.

Fig. 7 shows a fairly advanced young canal from a leaflet of *Marattia cicutæfolia*, which is interesting as illustrating a later stage of such a condition as seen in fig. 6. This is not a double canal, as sections both above and below the level of the section figured showed a single cavity. In the present case two cells in the same straight line have been drawn out through the increase in the size of the cavity. Owing to the shrinkage of the protoplasm, the walls of these cells were very clearly visible. Such cells which locally extend across the cavity of a young canal may be called *bridge-cells* (*br.c.*, figs. 6 and 7). As the cavity increases still further in size the bridge-cells, when present, get torn away from their attachment where it is weakest and project further into the cavity than their sister cells. In one case, in a young canal in the root of *Marattia attenuata*, a remarkable example of accommodation to tension was observed. The original wall of a bridge-cell had been ruptured transversely to its long axis, and within this was seen the much-elongated protoplast of the bridge-cell, of uniform thickness throughout its length and clothed with a new wall. These bridge-cells, which can only exist as such when the canal is still young, show no signs of mucilaginous degeneration, their walls and contents being evidently in the living condition, just as are those of the adjacent epithelium. The epithelium itself is so well marked and distinctly differentiated in the younger canals, that it is quite out of the question that it should be only an *apparent* epithelium resulting from the compression of the surrounding parenchyma by the mucilage, as was asserted to be the case by Kühn for the Marattiaceæ *generally*, although his observations were only made on roots, and in only one species of each of the three genera which he examined.

Fig. 8 represents a mature canal in a condition not infrequently found, even in old fronds, and it is difficult indeed to reconcile the appearance of its epithelium with Kühn's statement just referred to *. The cell *br.c.'* was probably a bridge-cell in the young condition of the canal, and the appearance at *b* is probably due to an early tangential division in one of the initial cells. It is quite common to find adult canals in which it is difficult to recognize the epithelium at all, owing to its being compressed by the mucilage in the cavity, or perhaps owing to the epithelial cells being in a state of collapse after discharge of the mucilage, or secretion which ultimately become converted into mucilage. Careful examination, however, reveals that the epithelium is there, and it becomes at once evident on treatment with iodine, as its constituent cells contain numerous small grains which give the starch reaction. In longitudinal section the adult epithelial cells are seen to be considerably longer than broad (three to five times in *M. cicutæfolia*), with an evident nucleus and finely granular protoplasm. Their ends are sometimes square, sometimes pointed. There is some evidence that they occasionally break down, owing to the pressure of the secretion, but such appearances are rare and were only observed in old canals.

In the young developing canals of the frond of *Angiopteris evecta*, *Marattia alata* and *M. cicutæfolia*, there is little or no sign of mucilage, for there does not seem to be anything more highly refractive than the mounting medium in the schizogenous space, nor anything which stains appreciably with safranine or hæmatoxylin; whereas in the adult condition the cavity is filled with a substance, "mucilage," which stains strongly with these reagents. It is possible, however, that a secretion might be present which is readily soluble in water, through which all the sections were passed before examination. The mucilage of the adult canals, however, is not at all readily soluble in water, only swelling therein. The true mucilage-canals found in the root of

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* In 'Flora,' 1889, p. 481.

Marattia attenuata show certain differences in this respect, and will be dealt with separately.

The development of the canal, even when pursuing a longitudinal course, is not strictly acropetal, as the schizogenous space may vary irregularly in width at different levels in the same developing canal. In the petioles and rachides, especially of the second and third order, where the canals pursue a pretty straight course, they taper fairly uniformly towards the apex except where disturbed by a lateral anastomosis. Further, the separate canals are frequently at very different stages of development at the same level. For example, in the case of a very young leaflet of *Marattia cicutæfolia,* in which there were three canals in the parenchyma of the mid-rib, the solitary canal on the upper side of the bundles was much wider than either of the two in the parenchyma on the under side and was longer in dying out. Moreover, a certain amount of basipetal development may be presumed to take place in certain cases, as in the tertiary pulvinus, or pulvinoid thickening at the base of a leaflet, the canals die out in the downward direction, tapering towards their proximal end. This would be accounted for if the parenchyma of the pulvinus remained longer meristematic than in the rest of the frond, of which there is indeed some sign.

True mucilage-canals, although obviously present in the stem and fronds of *Angiopteris evecta* (var. *hypoleuca*?), were *not* found in the roots, aerial or other, nor in the aerial roots of the type species. In these there were only elements, both isolated and in rows, which gave the tannin reaction with iron (blue), confirmed by the bichromate of potassium test. Such of the tannin-sacs as form longitudinal rows frequently seem to have an epithelium, especially seen in transverse section. Study of developmental stages, however, clearly showed that the appearance was simply due to the pressure of the contents of the tanniferous cells on the surrounding parenchyma; but even in the adult condition this pseudo-epithelium is very different in appearance from that of the true canals. The appearances presented by these tannin-sacs in their early stages are exceedingly like what Kühn has described and figured as illustrating the "lysigenous" development of the mucilage-canals, but they are not at all like the early stages in the development of the true canals as described above.

In the aerial roots of *Angiopteris evecta,* var. *pruinosa* and var. *Teysmaniana,* there are mucilage-cavities which form a well-marked ring in the cortex. Here there is no appearance of an epithelium whatever, and the parenchymatous cells of this region secrete mucilage into the intercellular spaces, which thereby become much distended, ultimately breaking down the adjacent cells and giving rise to a great cavity filled with mucilage. It is probable that there is a considerable amount of mucilaginous degeneration of the cell-walls, and it is even quite possible that the cavities are primarily due to this. These cavities filled with mucilage would be well described by Tschirsch's term "schizo-lysigenous" *. In portions in which the whole of the xylem had already become lignified, these peculiar mucilage-cavities seemed to be in many stages of development.

In the aerial roots of *Marattia attenuata*, although the origin of the canals is obviously schizogenous, and a well-marked epithelium is early distinguishable, yet the initial meristematic groups are not clearly differentiated in the young parenchyma. Moreover, at a very early stage the schizogenous space is filled with a deeply-staining substance, probably mucilage, which does not seem to be materially added to as the cavity becomes larger, for it is not till the canals are approaching the adult condition that they are again filled with a clearly recognizable mucilage. It may be that the mucilage secreted at this early stage is correlated with the formation of the schizogenous space. In the roots of this species the young canal is often very irregular in shape, and bridge-cells are very frequent. When the canal becomes too wide for these cells to accommodate themselves to the increasing tension, they are torn away at certain parts, and in transverse section a number of them are frequently seen projecting into the cavity, beyond the other epithelial cells, much more prominently than, though similar to, *br.c′*. in fig. 8.

Although the object of the present investigation was simply to determine whether or not there were true mucilage-canals developed schizogenously in the Marattiaceæ, a word may not be out of place with regard to the question whether secretory glands and canals conform to one typical mode of origin or another, or whether there is likewise a mixed development. Although a large amount of work has already been done in this direction, the matter hardly seems finally settled, even by Mlle. Leblois' work †. She finds that all such structures, in the thirteen families examined by her, are typically schizogenous in origin. She sums up her results as follows:—"Nous pouvons donc dire que dans tous les cas étudiés les canaux sécréteurs et les poches sécrétrices se constituent par écartement de cellules et jamais par destruction de tissu. Le mode de formation de ces organes est *schizogène* et non *lysigène*" *. The *typical* schizogenous development of the mucilage-canals of the Marattiaceæ would bring another important group into agreement with v. Tieghem and Mlle. Leblois' views, but for the peculiar canals in the roots of *Angiopteris evecta* var. *pruinosa* and var. *Teysmaniana*, in which the origin is schizogenous, but not *typical*, as subsequently lysigenesis takes place. Tschirsch favours a schizogenous origin with a lysigenous development in certain cases, and other careful observers previously found certain of these structures to be lysigenous which Mlle. Leblois considers schizogenous. Only exhaustive examination of every doubtful case by the aid of the most refined modern methods will afford a true basis for generalization, and that has yet to come.

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* 'Angewandte Pflanzenanatomie,' vol. i. p. 517 (1889).

† Leblois, Mlle. A., "Recherches sur l'origine et le développement des canaux sécréteurs et des poches sécrétrices." 'Annales des Sciences Naturelles,' 7ᵉ série, Botanique, tom. v., vi. (1887).

Summary.

Typical mucilage-canals occur in the Marattiaceæ, *i. e.* schizogenous intercellular spaces with a living secretory epithelium. This was actually demonstrated in the fronds of *A. evecta*, *Marattia alata* and *M. cicutæfolia*. They are in every essential feature similar in mode of origin and development to the well-known resin-canals of *Hedera*, *Pinus*, &c., and are *not* produced by the mucilaginous degradation and death of cells.

No mucilage-canals were found in the roots of *A. evecta* and *A. evecta* var. *hypoleuca* ?, but rows of tannin-sacs which simulated canals.

In the aerial roots of *A. evecta*, var. *pruinosa* and var. *Teysmaniana*, a ring of peculiar mucilage-cavities was found in the cortex; these cavities have no secretory epithelium, and seem to have a schizo-lysigenous mode of origin.

True mucilage-canals were found in the roots of *Marattia attenuata*, in which the only variation from the commoner mode of development was the want of definiteness in the earliest stages of the initial group and the very frequent irregularity in the development of the split.

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* In Ann. Sc. Nat. 7^{e} sér. Bot. v., vi. (1887), p. 315.

Bret. 1

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J. N. Fitch lith.

MUCILAGE CANALS OF MARATTIACEÆ.

EXPLANATION OF PLATE XXXVII.

Figs. 1, 2, 3. Early stages in development of mucilage-canal before the cavity has begun to form. *a*, the canal initials. From transverse sections of a young petiole of *A. evecta*, × 300.

Figs. 4, 5, 6. Early stages in development of schizogenous space. Fig. 4, simplest possible case. *a* in fig. 6 is a bridge-cell. From transverse sections of the young petiole of *A. evecta*, × 300.

Fig. 7. Advanced stage of a young canal showing how increase in size of cavity draws out the bridge-cells, *a*. *ep.*, epithelium. From transv. sect. of a young leaflet of *M. cicutæfolia*, × 300.

Fig. 8. Adult canal showing epithelium, *ep.*, clearly; *a*, probably once a bridge-cell, and *b*, doubtless due to early tangential division of a canal initial. From transv. sect. of a primary rachis of *M. cicutæfolia*, × 300.

THELOTREMEÆ et GRAPHIDEÆ novæ quas præsertim ex hb. Reg. Kewensi exponit Dr. J. MÜLLER, F.M.L.S. (Presented with the sanction of the Director, Royal Gardens, Kew.)

[Read 1st November, 1894.]

1. OCELLULARIA GLAZIOVII, *Muell. Arg.*; thallus pallide olivaceus, crassiusculus, ruguloso- et gibboso-inæqualis, superficie ipsâ levis et nitidulus apothecia evoluta adnato-sessilia, plana, 2–3 mm. lata, margine thallino nano subtenui integro et incurvo-obtuso cincta; discus planus, pro genere amplus, strato cæsio-albo obtectus et rimis numerosis centrum versus convergentibus eleganter ornatus; perithecium interius fusculum, parte basali in columellam nigram multiplicem, laminam perpendiculariter penetrantem evolutum; asci 8-spori; sporæ 18–22 μ longæ, 7–10 μ latæ, oblongo-ellipsoideæ, (4-)6-loculares.—Est species admodum insignis. Primâ fronte quasi formam macrocarpam simulat *Ocellulariæ schizostomatis*, Muell. Arg., sed margo et lamina multipliciter columelligera et sporæ latiores minus divisæ omnino differunt. Subsimile *Phæotrema anamorphoides*, sc. *Thelotrema anamorphoides*, Nyl. in Flora (1869), p. 120, differt margine lacero incurvo, disco poroso et sporis fuscis; et *Phæotrema Auberianum*, Muell. Arg., habitu magis accedens recedit apotheciis minoribus et sporis fuscis.—Corticola, in Prov. Rio de Janeiro: *Glaziou*, n. 5531 pr. p., 5548 pr. p., 5578.

2. **Ocellularia crispata**, *Muell. Arg.*; thallus albus, tenuis, rimulosus et obsolete granuloso-asperulus; apothecia $\frac{1}{2}$–1 mm. lata, leviter emergentia, orbicularia, basi constricta, mox late aperta; margo recurvo-patens et lobatus, crispulus pulverulentus; discus planus, depressus et strato niveo obtectus; perithecium intus undique hyalinum et columella basilaris dein deficiens; sporæ 8næ, hyalinæ, oblongato-ellipsoideæ, 15–17 μ longæ, 6 μ latæ, 6–7-loculares.—Prope validiorem *Ocellulariam efformatam*, sc. *Thelotrema efformatum*, Krempelh. in Flora (1876), p. 221, et magis macrosporam australiensem *O. pulchram*, Muell. Arg. in Nuov. Giorn. Bot. Ital. xxiii. p. 395, inserenda est.—Corticola, prope Rio de Janeiro: *Portella.*

3. **Ocellularia dilatata**, *Muell. Arg.*; thallus olivaceo-glaucus, tenuissimus, levis, rimulosus, subevanescens; apothecia innato-emergentia, ex orbiculari 2–4plo longiora quam lata, simplicia v. sæpius bifurcata et astroideo-trilobata, circ. 1 mm. lata, plana; margo tenuis, undulatus et crispulus, erectus, cæterum nec dentatus nec fissus, extus nigrescenti-glaucus; discus planus, strato niveo obtectus, levis integer; perithecium intus undique hyalinum, basi non columelligerum; sporæ 2-seriatim 8næ (hyalinæ), 23–27 μ longæ et 7–8 μ latæ, 8-loculares.—Species hæc apotheciis irregulariter dilatatis insignita et juxta *O. schizostoma*, Muell. Arg., inserenda est. Ab *O. latilabra*, sc. *Thelotremate latilabro*, Tuck. Obs. 1864, p. 269, jam margine valde tenui differt.—Corticola, in prov. Rio de Janeiro: *Glaziou*, n. 5531 pr. p.

4. **Ocellularia elabens**, *Muell. Arg.*; thallus argillaceo-albus, tenuissimus, continuus et levis, farinulentus; apothecia circ. $\frac{1}{2}$ mm. lata, paullo emergentia, orbicularia v. oblongo- v. astroideo-triloba, mox late aperta; margo recurvus, fissus et crispulus, demum quoad lobos evanescens et apothecia tum habitum integro-lecanorinum ostendentia; discus livido-obscurus v. demum nigrescens, planus, nudus; perithecium intus undique hyalinum; columella centralis deficiens; epithecium olivaceo-nigricans, lamina cæterum hyalinæ; paraphyses copiose hyphemoideo-vestitæ; sporæ hyalinæ, 2–4næ, circ. 40 μ longæ et 8 μ latæ, utrinque late obtusæ, fere undique æquilatæ, circ. 14–17-loculares.—Habitu ad *O. crispatam*, Muell. Arg., accedit, sed sporæ magis divisæ ut in dissimili *O. pulchra*, Muell. Arg.—Corticola, in Brasiliâ.

5. OCELLULARIA EMERSELLA, *Muell. Arg.*; *Thelotrema schizostomum*, Krempelh. in Flora (1876), p. 222, non autem *Th. schizostomum*, Tuck. Obs. 1862, p. 411, quod est *Ocellularia schizostoma*, Müll. Arg. in Nuov. Giorn. Bot. Ital. xxiii. p. 395, nec *Trypethelium schizostomum*, Leight. in Trans. Linn. Soc. xxvii. p. 184, quod nunc *Thelotrema schizostomum*, Muell. Arg.—A simili *O. emersa*, Muell. Arg. in Flora (1886), p. 310, sub n. 1037, differt apotheciis paullo minoribus, margine acutiore, aperturâ magis acutangulâ et dein sporis duplo brevioribus. Perithecium interius basi late et breviter in columnulam evolutum est.—Corticola, prope Rio de Janeiro: *Glaziou*, n. 3260.

6. THELOTREMA ANNULATUM, *Muell. Arg.*; thallus glauco-albidus, tenuissimus, continuus et sublevis, opaco-farinulentus; apothecia $\frac{2}{3}$ mm. lata, depresso-hemisphærica, leviter prominentia, regularia et levia; margo obtusus, interior lineâ annulari simplice v. duplice (imo et triplice) indicatus, haud prominens; discus parvus, niger, strato albido tectus, demum subnudatus; hypothecium nigrum; columnula basalis nulla; sporæ in ascis 2–4næ, ellipsoideo-cylindricæ, 70–85 μ longæ, 20–25 μ latæ (hyalinæ), copiose parenchymaticæ; locelli in series transversales circ. 20 dispositi, in quaque serie 4–5.—Species parum conspicua facileque effugiens, juxta ceylonense *Th. disciforme*, Leight. in Trans. Linn. Soc. xxvii. p. 170, locanda est.—Corticola, in prov. Rio de Janeiro: *Glaziou*, n. 5474.

7. THELOTREMA PRÆSTANS, *Muell. Arg.*; thallus olivaceo-albidus v. subargillaceus, tenuis, continuus et levis v. sublevis, maculis orbicularibus subregulariter sparsis copiosis hinc inde acute circumscriptis niveo-farinosis $\frac{12}{100}$–$\frac{18}{100}$ mm. latis (intus globoso-concavis) ornatus; apothecia 2–2½ mm. lata, regulariter orbicularia, subdepresso-hemisphærica, levia, basi sensim in thallum abeuntia, apice depresso albido-ostiolata; ostiolum haud prominens, integrum, $\frac{2}{3}$ mm. latum aut minus; perithecium interius undique completum, subnigrum; lamina aquoso-hyalina; sporæ solitariæ, 100–180 μ longæ, 30–38 μ latæ, utrinque paullo angustatæ copiose parenchymatosæ.—Est proximum *Th. depresso*, Montg., a quo recedit thallo pallidiore niveo-orediosulo et apotheciis amplioribus et minus depressis.—Corticola, prope Rio de Janeiro: *Portella*.

8. THELOTREMA SCHIZOSTOMUM, *Muell. Arg.* (*non Tuck.*); hic spectat *Trypethelium schizostomum*, Leight. in Trans. Linn. Soc.

xxvii. p. 184. Jam anno 1862 cl. Tuck. aliam cubensem et similem speciem sub *Thelotrematis schizostomi* titulo edidit, sed hæc est genuina species *Ocellulariæ*, sc. *Ocellularia schizostoma*, Muell. Arg. in Nuov. Giorn. Bot. Ital. xxiii. p. 395. Nomen specificum Leightoni etiamsi altero junius, in genere *Thelotremate* ergo admitti potest.—Apothecia evoluta demum emersa circ. 1 mm. lata; discus demum latius apertus, albus, radiatim varie fissus; perithecium interius haud distinctum v. fuscidulo-fulvescens; sporæ 8, hyalinæ, subuniseriales, 14–16 μ longæ et 8–10 μ latæ, 4-loculares, loculi intermedii bilocellati.—Corticola, prope Rio de Janeiro: *Glaziou*, n. 5548.

9. Phæotrema melanostomum, *Muell. Arg.*; *Ascidium melanospermum*, Krempelh. in Flora (1876), p. 248, incluso *Ascidio rhabdosporo*, Krempelh. l. c. p. 249 (non Nyl.), cum forma *lævigata*, Krempelh. l. c. Planta hæc a novagranatensi *Ascidio rhabdosporo*, Nyl. in Prodr. Nov. Gran. p. 552, differt sporis multo latioribus et ostiolis. Apothecia in eodem thallo ludunt grossius aut tenuius tuberculoso- aut verrucoso-aspera aut sublevia, et punctula nigra circa ostiolum in annulum confluunt aut segregata sunt aut pro parte aut omnia obtecta sunt, unde numeri citati omnes in formam unicam haud dividendam bene coadunandi sunt. Sporæ hyalinæ proventu bene obscuratæ sunt.—Corticola, in prov. Rio de Janeiro: *Glaziou*, nn. 5573, 3259, 5571, 6270, 6335.

10. Tremotylium Sprucei, *Muell. Arg.*; thallus fulvescenti-pallidus, levis, tenuissimus, subevanescens; apothecia diplo-monocarpica, simplicia 1 mm. lata, sæpe varie agglomerato-conferta, cartilagineo-firma, sessilia, subglobosa, basi constricta, fulvo-pallida et levigata, ore late truncata et obtuse integro-marginata; ostiolum paullo depressum et circumscissum, obscure purpurascens; perithecium interius rufo-nigrum, completum, apice connivens; paraphyses connexæ; sporæ in ascis 4–8næ, hyalinæ, circ. 110 μ longæ et 25 μ latæ, crebre parenchymatosæ, series transversales locellorum 20–25.—Est Lichen valde insignis, quodammodo *Trypethelii* more crescens. Greges apotheciorum basi paulo constricti et apothecia 2–6 quasi trunco communi brevissimo abeuntia.—Corticola, prope Santarem in regione amazonica Brasiliæ: *Spruce*, n. 187.

11. Platygrapha inferior, *Muell. Arg.*; thallus albidus aut subalbus, tenuissimus, subfarinosus, effusus; apothecia ½–1 mm. lata, sessilia, basi constricta, juniora tota albido-pruinosa, demum

subepruinosa et cinereo-nigrescentia, haud crassa, plana; margo mediocris, prominens, e regulari demum undulato-irregularis; discus planus, tarde undato-niger; hypothecium crassum, subnigrum, lateraliter in marginem non adscendens, unde margo in sectione omnino albo-thallinus; sporæ (in specim. costaricensi) 8næ, 27–35 μ longæ et 3–4 μ latæ, inferne longius angustatæ, vulgo arcuatæ, 4-loculares.—Hic etiam spectat Lichen quem nuperrime in Bull. Soc. Bot. Belg. xxxii. p. 148 ad *Pl. undulatam*, Muell. Arg. (*Lecanora undulata*, Fée), retuli et specimina illa hb. Féeani quæ a cl. Nylander in Ann. Sc. Nat. sér. IV. xi. ad *Pl. epileucam*, Nyl., relata fuerunt et quæ antea pro statu juniore *Pl. undulatæ* ipse habui, sed certe tamen ab ambabus differt. Thallus enim est minus firmus, leviter farinulentus, apothecia quam in *Pl. undulata* evidenter minora, multo minus crassa, margo tenuior et sporæ validiores. In *Pl. epileuca* sporæ 7-septatæ indicantur. *Pl. bimarginata* Nyl. demum etiam valde similis sed nudior est et sporæ magis divisæ sunt.—Corticola, in prov. Rio de Janeiro: *Glaziou*, n. 18043 (sine sporis), et in Costa Rica ad Boruca.

12. PLATYGRAPHA FLEXUOSA, *Muell. Arg.*; thallus albus, tenuissimus, ambitu levis, cæterum demum rugulosus; lirellæ graphidimorphæ, primum innatæ, dein cum margine thallino cum thallo concolore tumidulo emergentes, ambitu variæ, $\frac{1}{3}$–2 mm. longæ, $\frac{1}{4}$ mm. latæ, novellæ angustissime lineares, demum aut crebre anfractuoso-flexuosæ aut alternatim flexuoso-gibbosæ, apice nudo-nigræ, madefactæ pallescentes; discus planus, rimiformi-angustus; epithecium fuscum; hypothecium hyalinum; paraphyses connexæ; asci anguste cylindrico-obovoidei, 8-spori; sporæ 27–36 μ longæ, 5 μ latæ, fusiformes, 6–8-loculares.—Juxta paraguayensem *Pl. carneam*, Muell. Arg., quæ longe tenerior et carneo-pallida, locanda est.—Ad lignum Palmarum in ins. Barbados: *Anderson*.

13. PLATYGRAPHA MULTILOCULARIS, *Muell. Arg.*; thallus cinereo-albidus, maculiformi-tenuis et levis; apothecia $\frac{1}{4}$–$\frac{1}{2}$ mm. lata, orbicularia et regularia v. anguloso-trigona v. etiam leviter oblongata, solitaria v. hinc 2–3natim in seriem confluentia, crassiuscula marginata, emersa basique paullo constricta; margo thallo albior, integer; discus fusco-niger, madefactus fuscus, nudus; epithecium fuscidulum; hypothecium hyalinum; paraphyses connexæ; asci angusti, 8-spori; sporæ 52–65 μ longæ,

6–7$\frac{1}{2}$ μ latæ, anguste fusiformes, 16–20-loculares.—Perithecio interiore lateraliter et subtus deficiente cum dissimili et cæterum diversa *Pl. flexuosa* convenit et dein sporis pro hoc genere insigniter multilocularibus distincta est.—Corticola, in insula Barbados: *Anderson.*

14. Opegrapha (§ Euopegrapha) fertilis, *Muell. Arg.*; thallus albus, haloniformi-tenuis, evanescens; lirellæ admodum copiosæ et subæqualiter dense dispersæ, $\frac{1}{4}$–1 mm. longæ, sæpius $\frac{1}{2}$–$\frac{2}{3}$ mm. æquantes, $\frac{15}{100}$–$\frac{20}{100}$ mm. latæ, lineares et simplices, opaco-nigerrimæ, obsolete rudiusculæ, siccæ apice obtuse modice sulcatæ, madefactæ ibique planiusculæ; labia subacuta et leviter distantia; perithecium nigrum, basi attenuatum; asci elongato-obovoidei, membrana apice distincte incrassata; sporæ 8næ, 18–20 μ longæ, 3$\frac{1}{2}$–4 μ latæ, tenuiter digitiformes, 4-loculares.—Admodum affinis *O. atratulæ*, Muell. Arg., sed thallus albior, lirellæ nigerrimæ et rudiusculæ, labia acutiora, magis distantia et perithecium basi attenuatum.—Ad ligna vetusta, in insula Barbados: *Anderson.*

15. Opegrapha (§ Euopegrapha) palmicola, *Muell. Arg.*; thallus albus, tenuissimus, orbillas subregulares 2$\frac{1}{2}$–3 cm. latas maculiformes efficiens; lirellæ immersæ, demum leviter emergentes 1–3 mm. longæ, $\frac{25}{100}$–$\frac{30}{100}$ mm. latæ, lineares, simplices et bifurcatæ, sæpius varie curvatæ et subflexuosæ, sæpius utrinque longius acuminatæ, parte emersâ thallino-marginatæ, demum apice planæ et nudæ; perithecium nigrum, sub laminâ incrassatum; asci cylindrico-ovoidei, 8-spori; sporæ 20–23 μ longæ, cum halone 5 μ latæ, anguste fusiformes, 8-loculares.—Species valde distincta, habitu *Graphidem scriptam*, Ach., satis simulans, sed e paraphysibus connexo-ramosis et e divisione characteristicâ sporarum ad *Opegrapham* pertinet et in hoc genere prope *O. melanogramma*, Krempelh., locanda est.—Ad lignum Palmarum, in insula Barbados: *Anderson.*

16. Opegrapha (§ Lecanactis) ulcerata, *Muell. Arg.*; thallus cinereus, tenuis, subplicatulus et demum rimulosus (lenticellis subjacentibus spurie gibbosus); apothecia evoluta sessilia, orbicularia v. subangulosa, $\frac{1}{4}$–$\frac{1}{2}$ mm. lata, plana v. subplana, tenuiter nigro-marginata, nigra et nuda, thallo circumcirca ulceroso quasi annulo latiusculo albo cincta, novella exigua distincte lirelliformia, 2–3plo longiora quam lata v. etiam suborbicularia; perithecium nigrum, basi contractum ibique tamen in centro late deficiens;

sporæ in ascis angustis 8næ, circ. 17 μ longæ et $4\frac{1}{2}$ μ latæ, digitiformes, regulariter 4-loculares.—Species juxta *Op. chloroconiam*, Muell. Arg. in Flora, lxv. (1882) p. 331, inserenda est.—Corticola, ad Caput Bonæ Spei: *MacOwan.*

17. Opegrapha (§ Pleurothecium) angulosa, *Muell. Arg.*; thallus argillaceo-albidus, tenuis, rugulosus; lirellæ $\frac{1}{2}$–$1\frac{1}{2}$ mm. longæ, $\frac{4-5}{10}$ mm. latæ, simplices v. rarius divisæ, rectæ et curvatæ, primum innatæ et tantum lineâ rimali nigrâ conspicuæ, acutæ, demum alte prominentes et obtusæ et impure nudatæ, in vertice secus rimam utrinque stratulo corticali sat diu persistente pallido fasciatæ et bicolores factæ, infra fascias lateraliter mox nudato-nigræ et longitrorsum subangulosæ, apice arcte conniventes; perithecium nigrum, basi sub laminâ nullum, lateraliter patens, in sectione pyramidali, unde lirellæ totæ in sectione superne subacutæ; sporæ in ascis cylindrico-obovoideis 8næ, ascis subtriplo breviores, 28–33 μ longæ, cum halone $6\frac{1}{2}$ μ latæ, 7–8-loculares.—Prope *Op. tartaream*, Muell. Arg., intercalanda est. Ex apice regulariter aut irregulariter thallino-bifurcato aut nudo aut hinc inde transversim plicatulo, et transversim fasciato valde ludit et dein subinde lirellas compositas aut peculiariter proliferas simulat.—Corticola, in tactu montis Pouce in ins. Mauritii: *Dr. Ayres.*

18. Graphis (§ Aulacogramma) turgidula, *Muell. Arg.*; thallus albidus, tenuissimus, obsolete rugulosus: lirellæ $\frac{1}{4}$–2 mm. longæ, $\frac{3}{10}$ mm. latæ, simplices et rectæ v. subrectæ, sparsæ, nigræ, elato-emersæ, basi utrinque dimidia altitudine thallino-corticatæ, cæterum nudæ et aterrimæ; labia conniventia, turgidula, ad latera levissime sulcato-unistriolata; perithecium nigrum, basi valide completum; sporæ circ. 6næ, circ. 65 μ longæ et 11 μ latæ, 12–15-loculares.—Juxta *Gr. rimulosam*, Muell. Arg., inserenda est, a quâ differt lirellis alte emersis, non lamelloso-sulcatis, abbreviatis et magnitudine sporarum. Primâ fronte quasi *Gr. lineolam* validam lirellis magis emersis simulat.—Corticola, in summitate montis Pouce, in ins. Mauritii: *Dr. Ayres.*

19. Graphis (§ Aulacogramma) flavicans, *Muell. Arg.*; thallus virenti-flavicans, tenuissimus, continuus, obsolete rugulosus et nitidulus; lirellæ copiosæ, 3–5 mm. longæ $\frac{1}{4}$ mm. latæ, intricatim arcuatæ et simul flexuosæ longe acuminatæ, utrinque primum undique et dein circiter pro $\frac{2}{3}$ altitudinis thallino-corti-

catæ, juniores apice lineæ instar nigræ, evolutæ superne latius pure nigræ; labia conniventia, longitrorsum 3–4-fissæ; perithecium nigrum, basi valde completum; sporæ 8næ, juniores circ. 70 μ longæ 11 μ latæ, longo tractu æquilatæ, 12-loculares (bene evolutæ verisimiliter majores et loculi numerosiores).—Inter *Gr. tenuescentem*, Nyl., et *Gr. flexibilem*, Krempelh., inserenda est.—Corticola, in prov. Rio de Janeiro: *Glaziou*, n. 5498 pr. p., cum *Gr. tenuescente* mixta.

20. GRAPHIS (§ FISSURINA) GOMPHOSPORA, *Muell. Arg.*; thallus flavescenti-glaucus, crassiusculus, valide rugoso-glebosus, superficie levis et nitidulus; lirellæ circ. 1–2 mm. longæ, juniores vix nisi rimulâ lineari indicatæ, dein magis emergentes, valide thallino-corticatæ, cum cortice $\frac{1}{2}$ mm. latæ, cum thallo concolores et leves; rimula ostiolaris demum albicans, semper angustissima; perithecium in sectione superne utrinque striguliforme, olivaceo-fusculum, cæterum hyalinum; discus concavus; hypothecium hyalinum; lamina in sectione $\frac{3}{10}$ mm. lata, basi late rotundato-obtusa; sporæ in ascis 8næ, late globoso-ellipsoideæ, utrinque rotundissimo-obtusæ, 4-loculares.—Habitu et characteribus optime accedit ad *Graphidem insidiosam*, ubi thallus et lirellæ satis conveniunt, sed ambitus sporarum et earum dimensiones differunt. —Corticola, in Pic du Pouce in ins. Mauritii.

21. GRAPHIS (§ FISSURINA) LECANORINA, *Muell. Arg.*; thallus albus, pulverulento-tenuissimus; lirellæ subemersæ, $\frac{1}{2}$ mm. longæ et latæ v. diametro leviter longiores, thallino-cinctæ; labia mox late hiantia, leviter prominentia; perithecium basi lata deficiens, lateraliter evolutum, latera in sectione inferne paullo patentia, fumoso-fuscidula v. fuscidulo-obscura, basin versus pallidiora; discus siccus niger, madefactus aquoso-pallens, suborbicularis et nudus; sporæ 8næ, 16–18 μ longæ, 8–9 μ latæ, utrinque late obtusæ, 4-loculares.—Species habitu singularis, fere *Ocellularia*, primo intuitu *Lecanoræ* speciem simulans, at structura perithecii est *Graphidis*. Juxta *Gr. platycarpellam*, Muell. Arg. in Bull. Soc. Bot. Belg. xxx. p. 81, inserari potest.—Ad truncos Palmarum, in insula Barbados: *Anderson*.

22. GRAPHINA (§ RHABDOGRAPHINA) TUBERCULIFERA, *Muell. Arg.*; thallus glauco-albidus, tenuis, nitidulus, crebre tuberculiformi- v. bulluliformi-rugulosus; lirellæ basi immersæ, valde elongatæ et subflabellato-ramosæ, majores 10 mm. longæ, $\frac{1}{2}$ mm.

latæ, ad latera valide thallino-duplicatæ, longitrorsum profunde plurisulcatæ, acie denudato-nigræ; perithecium nigrum, basi valide completum; sporæ in ascis 2–4næ, majores circ. 110 μ longæ et 25 μ latæ, crebre parenchymatosæ; locelli in series transversales 20–23 dispositi, in quaque serie 4–5.—Juxta *Graphinam subserpentinam*, Muell. Arg., sc. *Graphidem subserpentinam*, Krempelh. in Flora (1876), p. 381, non Nyl. (quæ thallo levigato, lirellis tenuioribus et ascis monosporis differt) locanda est.—Corticola, in prov. Rio de Janeiro: *Glaziou*, n. 11777. Ex eadem affinitate in hb. Kew adest species brachycarpa: *Graphina dealbata*, sc. *Graphis dealbata*, Nyl. in Flora, 1869, p. 123; Krempelh. in Flora (1876), p. 384; Burchell, n. 2098.

23. GRAPHINA (§ RHABDOGRAPHINA) PACHYPLEURA, *Muell. Arg.*; thallus albus v. glauco-albus, mediocris, demum rimosus, rugulosus et sublevis; apothecia conferta, vulgo simplicia, circ. ⅘–1⅓ mm. lata, longitudine diametrum semel usque ter æquantia, ambitu sæpius tamen late elliptica, recta v. subrecta, basi paullo innata, thallino-vestita; labia conniventia, longitrorsum profunde 3–5-lamelloso-sulcata; lamellæ in acie nudato-nigræ; perithecium nigrum, basi valide completum; sporæ in ascis solitariæ, hyalinæ, circ. 150 μ longæ et 25 μ latæ, crebre parenchymatosæ.—Est species insignis, apotheciis ambitu eximie latis et lamellosis, cæterum ad *Graphinam Acharii*, Muell. Arg., et *Graphidem albostriatam*, Wain., proxime accedens.—Corticola, prope Rio de Janeiro (*Glaziou*, n. 16671 pr. p.).

24. GRAPHINA (§ SOLENOGRAPHINA) CRASSA, *Muell. Arg.*; thallus argillaceo-flavicans, mediocris, continuus v. demum rimoso-fissus, superficie subpulveraceo-rugulosus, opacus; lirellæ superficiales, ambitu latæ, sæpius 1⅓ mm. latæ et 2 mm. longæ, cæterum longitudine 1½–3 mm. attingentes simplices, elevato-crassæ, basi paullo constrictæ, undique thallino-vestitæ, non verrucosæ, arcte conniventi-clausæ, quasi striolâ longitrorsâ tantum aperientes; perithecium nigrum, basi valide completum; labia integra; sporæ solitariæ, circ. 140–160 μ longæ, 25–28 μ latæ, dense multilocellosæ.—Habitu ad jamaicensem *Gr. granulosam*, Muell. Arg., accedit, sed lirellæ non sulcatæ nec grosse verrucosæ. Species in hâc sectione nulli arcte affinis et insuper habitu insignis ad *Graphinam cleistomma*, sc. *Graphidem cleistomma*, Nyl. Prodr. Nov. Gran. p. 134, accedens, sed lirellæ

robustiores, vertice non impressæ.—Corticola, in prov. Rio de Janeiro: *Glaziou*.

25. GRAPHINA (§ CHLOROGRAMMA) RHABDOCARPA, *Muell. Arg.*; thallus ochroleuco-albidus, mediocris, subrugulosus, demum diffracto-rimosus; lirellæ basi innatæ, inferne sensim in thallum abeuntes, simplices, rectæ, varie curvatæ, validiusculæ, thallino-corticatæ, longitrorsum sulcatæ, rimulâ fuscâ aperientes; perithecium pallidum, apice sub cortice in lamellas diviso fuscum v. fulvo-fuscum; sporæ 2–4næ, circ. 100 μ longæ et 22 μ latæ, dense locellosæ.—A simili *Gr. pallida*, Muell. Arg., differt lirellis paullo validioribus et rimâ fuscâ, a *Gr. fasciata*, Muell. Arg., thallo albiore et sporis majoribus et dein a *Gr. Lorentzii*, Muell. Arg., lirellis minus emersis, basi non constrictis et sporis non solitariis.—Corticola, prope Rio de Janeiro: *Glaziou*, n. 18046.

26. GRAPHINA (§ PLATYGRAMMINA) ALBA, *Muell. Arg.*; thallus albus v. nonnihil argillaceo-albus, tenuis, tuberculoso-ruguloso-asperulus, superficie firmus; lirellæ semiemersæ, breves, valide thallino-obtectæ; margines demum late hiantes et crispuli v. diffracti; discus planus et strato thallino tectus; perithecium basi deficiens, ad latera undique evolutum sed tenue, fulvo-fuscidulum; sporæ solitariæ, circ. 90 μ longæ et 33 μ latæ, crebre locellosæ, locelli in quâque serie transversali 5–7.—Habitu similis *Gr. obtectulæ*, Muell. Arg., e Costa Rica, sed lirellæ bene emergunt et sporæ multo majores sunt, et a proximâ *Gr. columbiana*, Muell. Arg., dein differt thallo non glaucescente, firmiore et apotheciis et sporis minoribus.—Corticola, in prov. Rio de Janeiro; *Glaziou*, n. 18042.

27. PHÆOGRAPHIS (§ MELANOBASIS) TREMULANS, *Muell. Arg.*; thallus flavescenti-pallidus, mediocris, leviter granoso-rugulosus, nitidulus; lirellæ stellatim in orbillam usque 12 mm. latam discreto-longiramem divisæ, rami parce dendroideo- aut dichotomo-divisi, superne sæpe peculiariter breviramillosi, undique subflexuosi, ex erumpente emergentes, $\frac{1}{2}$ mm. lati; margines prominentes, undique thallino-corticati, superne mox cinereo- v. subcæsio-pulverulenti et tremuloso-crispuli, demum irregulariter patentes; perithecium undique nigrum, sub laminâ incrassatum; discus niger et nudus; sporæ 8næ, circ. 20 μ longæ et 8 μ latæ, 4-loculares.—Juxta *Ph. diversam*, Muell. Arg., et *Ph. melano-*

stalazantem, Muell. Arg., locanda est, a quibus simul habitu, lirellis tenuioribus, minus apertis et sporis 4-locularibus differt. —Corticola, in insula mollucana Ternate.

28. PHÆOGRAPHIS (§ MELANOBASIS) MEDUSULIZA, *Muell. Arg.*; thallus olivaceo-albidus, tenuissimus, levis et nitidulus; lirellæ orbillas 2–4 mm. latas formantes, e centro circumcirca radiatim discreto-divisæ, rami $\frac{20}{100}$ mm. lati, simplices et semel v. bis dichotome divisi, in ambitu orbillarum circ. 10–17, recti v. subflexuosi, subinnati, nigri; margines vix prominuli, tenues; discus concavo-planus et nudus; perithecium lateraliter sat tenue, sub laminâ multo crassius, undique fusco-nigrum; sporæ 8næ, 16–18 μ longæ et 6–7 μ latæ, cylindrico-ellipsoideæ, 4-loculares. —A *Ph. sericea*, Muell. Arg., cui valde affinis est, recedit habitu medusulino, polyclado et ramis gracilibus, characteres interiores cæterum bene conveniunt. *Sarcographina olivacea*, Muell. Arg., dein etiam sat similis est, sed stromata decolorato-distincta in hâc novâ specie non adsunt.—Corticola, in ins. Mauritii: *Prof. I. B. Balfour*.

29. PHÆOGRAPHINA (§ ELEUTHEROLOMA) LIMBATA, *Muell. Arg.*; thallus olivaceo-fuscus, maculiformi-tenuis, levigatus; lirellæ ex emergente semiemersæ, $\frac{1}{2}$–2 mm. longæ, $\frac{1}{2}$ mm. latæ, simplices, rectæ, utrinque obtusæ, extus usque ad aciem strato thallino mox expallente obsolete crispulo obtectæ; labia madefacta distantia, apice nigra, integra; discus planus, nudus et niger; perithecium nigrum, basi late deficiens; sporæ 8næ, 24–30 μ longæ et 12–15 μ latæ, locellosæ, locelli in series 6 dispositi, in quâque serie 3 (–2).—Habitu universali ad *Ph. scalpturatum*, Muell. Arg., accedit, sed sporæ parvulæ, nec ulli nisi *Ph. Arechavaletæ*, Muell. Arg., arcte affinis est et a quâ recedit lirellis paullo majoribus, obtusis, extus limbatis. *Phæographis mesographa* s. *Graphis mesographa*, Nyl. in Prodr. Nov. Gran. p. 80, dein differt lirellis majoribus, subramosis, sporis duplo majoribus et magis divisis.—Corticola, ad Caput Bonæ Spei: *MacOwan*.

30. PHÆOGRAPHINA (§ EPILOMA) FLEXUOSA, *Muell. Arg.*; thallus fulvo-argillaceus, tenuissimus, obsolete granulari-asperulus, opacus; lirellæ ex erumpente subemersæ, $1\frac{1}{2}$–$2\frac{1}{2}$ μ mm. longæ, $\frac{1}{2}$ mm. latæ, simplices et hinc inde bifurcatæ, longiores varie arcuatæ et subflexuosæ, ad latera thallino-corticatæ; labia

obtusa, integra, conniventia, apice nudo cum rimâ sulciformi nigrâ; perithecium in sectione apice utrinque rufo-nigrum, cæterum pallidum, v. sub lamina anguste fulvum; epithecium fusco-nigrum; sporæ in ascis 2–8næ, 45–60 μ longæ, 15–22 μ latæ, multilocellosæ, locelli in series 8(–10) dispositi, in quaque serie 3–4.—Juxta *Ph. platyloma*, Muell. Arg., et *Ph. subsordidam*, Muell. Arg., ubi sporæ valde majores et solitariæ, inserenda est. A cel. Montagne, in Hook. Lond. Journ. Bot. iii. p. 3, pro *Opegrapha rigida*, Fée, habita et descripta, et dein a cl. Nylander, Enum. p. 134, sub *Lecanactide flexuosa* nominata et nuperius in suis Lich. Japon. p. 113 sub *Graphide flexuosa* breviter descripta fuit.—Corticola, in inss. Philippinis: *Cuming*, n. 2519.

31. ARTHOTHELIUM FERAX, *Muell. Arg.*; thallus e pallide olivaceo umbrato-fuscescens, tenuissimus, subrugulosus, apotheciis abortivis $\frac{1}{10}$–$\frac{2}{10}$ mm. latis orbicularibus v. paullo angulosis copiose adspersus; apothecia evoluta $\frac{3}{4}$–1 mm. lata, plano-convexa, orbicularia v. leviter et obtuse angulosa, extus opaco-nigra, intus olivaceo-nigra; sporæ 8næ, hyalinæ, 25–28 μ longæ, 10 μ latæ, elongato-obovoideæ, 6–8-loculares, loculi nonnulli intermedii semel longitrorsum divisi.—A simili et proxime affini *A. interveniente* (Nyl.) Muell. Arg., cujus sporæ conveniunt, differt thallo non albo et apotheciis subregulariter orbicularibus (et præsentiâ apotheciorum abortivorum). Ab *A. infuscato*, Muell. Arg. Consp. Lich. Nov. Zel. n. 628, dein recedit colore thalli et sporis minoribus.—Corticola, Tasmania: *Archer*.

32. CHIODECTON VIOLACEUM, *Muell. Arg.*; omnia plantæ albæ ut in *Ch. sanguineo*, Wain., sed margo thalli intense vinosoviolaceus aut obscure purpureo-violaceus; hypothallus similiter purpureo-violaceus.—Colore sanguineo-coccineus omnino deest. —Corticola, in Brasilia tropicâ: *Burchell*, nn. 1006–1007 (tantum sterilis lecta).

33. SARCOGRAPHA (§ PHÆOGLYPHIS) AURANTIACA, *Muell. Arg.*; thallus pallide argillaceo-albus, mediocris, reticulato-rimulosus; areolæ fertiles turgidæ et confertim fertiles; lirellæ irregulariter astroideo-ramosæ, intricatæ, prominulæ, strato thallino ore albiore obtectæ et subclausæ, dein marginibus obliterantibus apertæ et discus planus $\frac{12}{100}$ mm. latus nudus et læte aurantiacus, tum plane denudatus et cicatrices ipsæ marginum plus minusve aurantio-tinctæ; perithecium proprium in sectione discernendum

lamina aquoso-hyalina, basi in sectione transversali rotundata; sporæ in ascis uniseriatim 8næ, hyalinæ, 8–10 μ longæ et 4–5 μ latæ, 4-loculares.—Species colore disci et minutie sporarum insignita, nulli cognitarum arcte affinis est. Habitu accedit ad species *Medusulinæ*, sed sporæ non sunt parenchymaticæ.—Corticola, in Brasilia.

34. Medusulina microcarpa, *Muell. Arg.*; thallus fusco pallens, maculari-tenuissimus, levis, demum evanescens; apothecia exigua, erumpentia, circ. $\frac{1}{2}$–$\frac{3}{4}$ mm. tantum longa, angusta, simplicia et recta, cum annulo thallino obvallante turgido sæpius fere $\frac{2}{3}$ mm. lata, ambitu elliptica, solitaria aut 2–3-seriatim connata; labia nigricantia, conniventia, apice subnuda, demum hiantia; perithecium laterale, inferne patens, basi deficiens, fulvo-nigricans; sporæ 8næ, 15–18 μ longæ, 7–8 μ latæ, e 4–7-loculari modice locellosæ, locelli in quâque serie 2–3.—Juxta *Medusulinam nitidam*, Muell. Arg., locanda est, a qua differt pseudostromate purius albo, lirellis multo brevioribus et obscuris, margine proprio evoluta et sporis minoribus.—Corticola, prope Obidos in regione amazonicâ: *Spruce*, n. 304.

On Stipules, their Forms and Functions.—Part II. By the Rt. Hon. Sir John Lubbock, Bart., M.P., F.R.S., F.L.S.

[Read 21st June, 1894.]

In the twenty-eighth volume of this Journal (pp. 217–243) the Society has done me the honour of publishing a memoir on the forms and functions of Stipules, and I propose now to add some further observations on the same subject. Stipules serve for several purposes in the economy of plants, one of the most general being the protection of the young leaves in the bud. The young leaves are very delicate. Every gardener knows to his cost how susceptible they are to cold, and they afford a tempting food to insects and other animals. Moreover, their development is a slow process, the buds for the following spring being already formed in many cases during the preceding summer, even as early as June or July. These buds are in some cases protected by leaves, in others by scales, by hairs, by glands, by gum, by mucus; in many cases they nestle between the stem and the petiole of the leaf; and, lastly, in very many they are protected by the stipules.

This is not, however, the only function of stipules, which in some species are developed into spines, in others into glands, while in some they perform, or assist in performing, the function of true leaves.

In the following paper I propose to describe the form and arrangement of the stipules in many species, and the purpose they serve in the economy of the plants.

It will be seen that where stipules are absent there is generally some other arrangement for the protection of the bud; and as regards the special problem suggested by Vaucher in the case of the species of *Helianthemum*, further study fully confirms the suggestion that in those which have broad petioles the petioles serve for the protection of the bud, and there are no stipules; while where the petioles are narrow, stipules are developed and serve the same purpose. This, then, seems a complete and satisfactory answer to Vaucher's problem.

RANUNCULACEÆ.

Caltha.—In *Caltha* the leaves are simple; the petioles thick, flattened or slightly grooved above, and dilated and sheathed at the base. In the radical leaves the sheaths are membranous, colourless or pinkish, continuous with and connate for some distance with the edges of the leaves, then becoming free and forming a cylindrical sheath, which at first encloses the crown or axial bud of the plant. The sheaths of the cauline leaves are much shorter, and become free from the broadly-dilated, triangular, and amplexicaul base of the petiole. The sheaths become gradually shorter on the upper leaves.

Thalictrum aquilegifolium, Linn.—The leaves are at least triternate; the base of the petiole is widely dilated and amplexicaul, with the margins produced into thin, membranous, entire valves or flaps, which surround the stem and at first enclose the bud. Every trifurcation of the lamina of the leaf is subtended by membranous stipular processes, which appear to differ somewhat in their origin from the primary sheath. Behind the middle branch of the lowest trifurcation is a large obreniform or bifid stipella, with rounded lobes; at the other joints of the leaf this organ is bipartite.

In *T. javanicum,* Blume, the lobes of the primary sheath are fringed at the margin and traversed by branching veins. The secondary stipular sheaths are much smaller than in *T. aquilegifolium.*

Ranunculus aquatilis, Linn., var. *pseudo-fluitans*, Syme.—The aquatic Ranunculi, of which the above may be taken as a type, differ from the land-forms as regards the arrangement of the stipules, which are adnate to the petioles, with ovate or triangular, obtuse, free auricles or tips. They are membranous and attached all round the axis, so as to form a sheath. The terminal bud is enclosed by the stipules of the two uppermost expanded leaves. The developing leaves push their way out at the apex of the stipular sheath. Similarity of conditions have therefore developed in the aquatic Ranunculaceæ an arrangement very similar to that of the Potamogetons.

DILLENIACEÆ.

Hibbertia volubilis, Andr.—The leaves are exstipulate and shortly petiolate; the petiole is winged, articulated with a pedestal which is dilated, carried round the stem, and connate, forming a cup, which is obliquely one-sided, being very shallow at the point of union of the posterior edges. The leaf is conduplicate in bud, and the lamina unfolds first. The terminal bud is protected by two leaves; mainly by the oldest unexpanded, but partly by the youngest expanded leaf. The pedestal protects the base and the axillary buds; it persists a long time, even for years, after the leaf has fallen. In *H. dentata*, R. Br., the petiole is deeply channelled, but not winged.

In *Dillenia indica*, Linn., the terminal bud is surrounded by the concave and sheathing petiole of the last developed leaf, or that of one in the process of expansion. A small portion of one other leaf is exposed, but all are densely silky, attaining considerable size before expansion, and each in turn clasps and covers the next younger leaf more or less completely.

Axillary buds are seldom developed, although they form under the sheath of the petiole and are densely clothed with glossy pale brown hairs. The tree is therefore but sparingly branched.

Groom (Trans. Linn. Soc. ser. 2, Bot. vol. iii. p. 263) describes and figures bud-protection in *Wormia Burbidgei*, Hook. f., where the leaf-sheath (? adnate stipules) forms a cylindrical chamber enclosing the bud.

Potter (Journ. Linn. Soc., Bot. vol. xxviii. p. 346) describes and figures the bud-protection in *Wormia triquetra*, Rottb., by the adnate stipules.

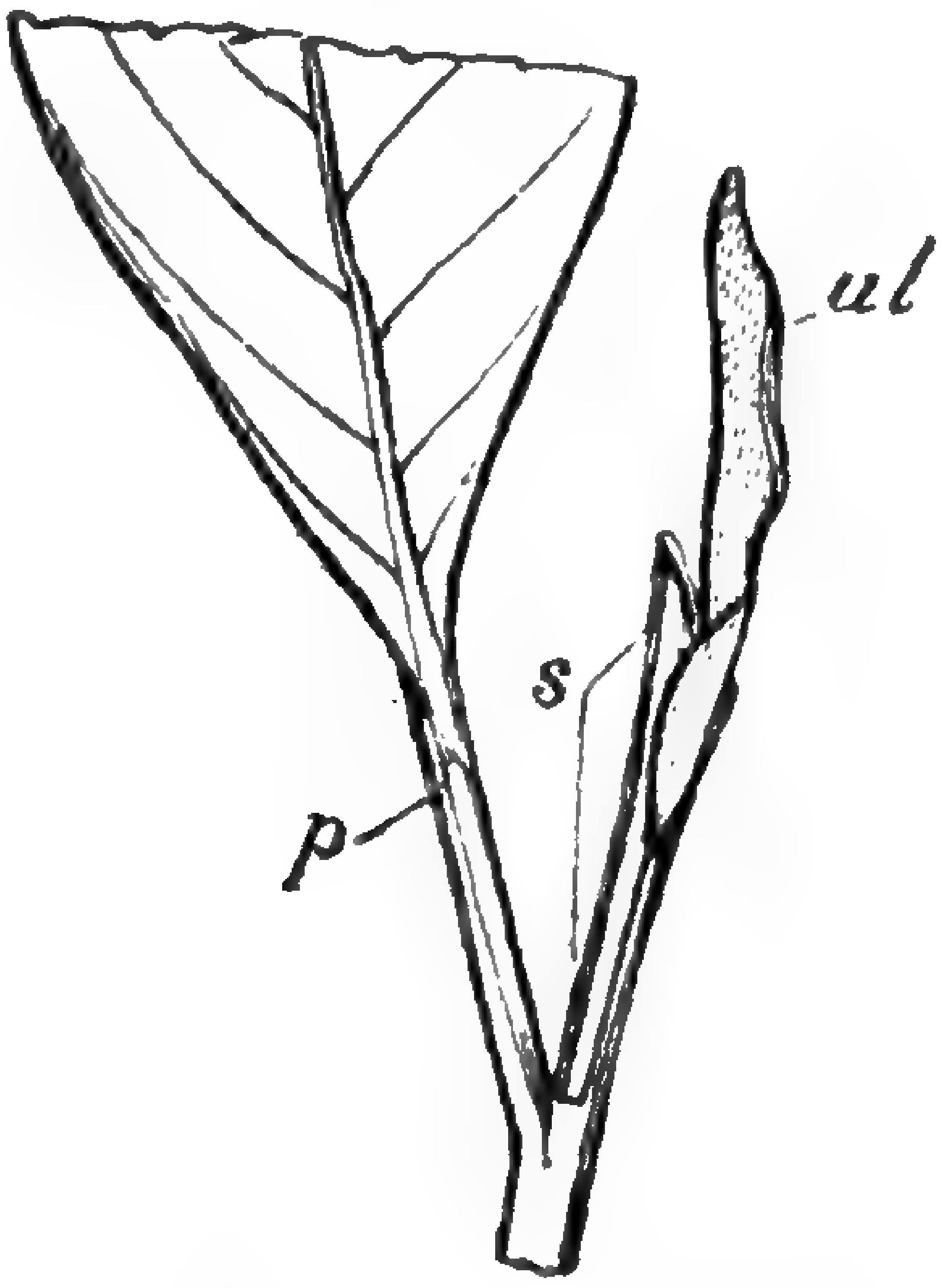
MAGNOLIACEÆ.

This order is one of those in which some species have, and others have not, stipules. As already mentioned (Journ. Linn. Soc. vol. xxviii. p. 223) the winter-buds in *Kadsura* are protected by the outer leaves, which are reduced to scales. In *Drimys* a few of the outer leaves of the resting-bud are reduced to small bract-like fleshy organs, which become green or red on the resumption of growth. The leaves in bud are convolute, two of the outer ones enclosing the rest.

In *Magnolia acuminata*, Linn., the stipules are adnate to the petiole for only half its length, and in *M. grandiflora*, Linn., at the very base only, connate at both edges, forming a cylindrical sheath, which encloses the bud, gradually splitting as the latter develops. The interesting case of *Liriodendron* I have already described (Journ. Linn. Soc., Bot. vol. xxiv. p. 84).

In *Magnolia glauca*, Linn., the winter-bud is covered by a pair of connate stipules adnate to a petiole that is less than half their length. As the bud lengthens in spring, the stipules split by a regular fissure and at the same time become almost separated from the petiole.

Fig. 1.



Magnolia glauca, ad nat.—*p*, point to which the stipule extended while still adnate in bud; *s*, stipule still adnate to unfolded leaf; *u.l.*, unfolded leaf, twice conduplicate longitudinally in the upper two-thirds to find room in the interior of the stipule, and twisted below this double folding.

Succeeding leaves are perfect, and each has a pair of stipules adnate to the top of the petiole while in the bud-stage, and connate along their posterior edges. The stipules further are two or three times as long as the petiole, the free portions being connate by both edges like a candle-extinguisher over the bud, so that their leaf appears to spring from the back. The lamina of the leaf is twice conduplicate, and the two folds one over the other slightly convolute round the upper portion of their own stipules.

As the bud lengthens the protecting stipules become dry and straw-coloured, the petiole remaining green; they gradually split or separate by a regular fissure at both edges and fall away either slightly united at the apex in pairs or separately. As they are adnate to the petiole, there is some reason to assume that the stipules once formed a sheath pure and simple to the leaf of some ancestral form. After expansion, the petiole elongates above the points to which the stipules were adnate.

The flower-buds are formed in autumn at the ends of the shoots, and are generally protected by four pairs of connate stipules adnate to a petiole without a lamina. In spring they behave in the same way as the stipules of the leaf-buds. The petiole of the leaf immediately enclosing the flower-bud is completely amalgamated with the stipules. Sometimes a perfect, though small lamina is produced with a petiole prolonged beyond the stipules, the free portion of which is short and triangular. The pair immediately enclosing the flower form a club-shaped cap in accordance with the shape of the flower and its peduncle.

Magnolia Umbrella, Lam. (syn. *M. tripetala*, Linn.), agrees in all essential points with the above as far as the stipules are concerned; but in some leaves the edges of the basal part of the lamina are adnate to the upper part of the stipular sheath, leaving only a small portion of the tip free.

In the monotypic genus *Lactoris*, comprising Engler's Lactoridaceæ and placed by him next to Magnoliaceæ from its affinity with *Drimys* (see 'Pflanzenfamilien,' Magnol. p. 19), the stipules form an ocrea-like structure embracing the succeeding internode. *Lactoris* is included by Bentham in Piperaceæ.

BERBERIDEÆ.

In *Lardizabala biternata*, Ruiz et Pav., stipules are absent, but the leaves of axillary shoots appear like stipules. When the shoots with their evergreen and leathery leaves are fully matured, the buds in the axils of the leaves swell up and produce a small, simple, obliquely-ovate or cordate leaf right and left of the axis.

These small leaves, owing to the first internodes of their axis not being developed, arise so closely to the base of the petiole of the large leaf that they appear to be the stipules of that half. After a time the axillary bud lengthens into a shoot, and a bud is developed in the axil of each of the small leaves at the base of the shoot. The third leaf on the axillary shoot is spathulate and much smaller than the first two, but becomes green and leathery. Succeeding leaves, to a considerable number in some instances, remain small, subulate, and bract or scale-like; in other cases the fourth to the seventh leaf inclusive remain small.

The leaves in the bud are divided into two or generally three leaflets, that is they are ternate; on the stronger ones more or less perfectly biternate, with the leaflets conduplicate. A large number of these in an advanced condition surround and protect the bud, and are afterwards carried widely apart by the elongation of the internodes. Meanwhile the axillary buds are protected by the base of the petiole and by the dilated persistent pedestal, on which the petioles are inserted. There are no stipules proper.

NYMPHÆACEÆ.

Nymphæa.—The stipules are intrapetiolar.

In *Nymphæa tuberosa*, Paine, the winter-bud is under water and consists of a dense or compact, conical mass of leaves in various stages of development intermingled with stipules and covered by the decaying remains of old leaves and their stipules.

Each half of the leaf is convolute longitudinally from the edge inwards to the midrib, including also the basal auricles.

The stipules are inserted on the edge of the dilated pedestal of the leaf-stalk, and below the articulation of the latter; and are connate in one plate-like piece in front of the petiole. They are therefore intrapetiolar, and attain a length of 1·8–3·5 cm. They are emarginate or variously dentate at the apex, and have a thickened portion corresponding to the midrib. From the basal outer face of each petiole arises a slimy mass of long hairs, which lie therefore in front of the stipules of older leaves.

The object of these stipules seems to be to protect the tender young leaves of the bud from fishes and other aquatic animals that feed on vegetation. They are kept at bay not only by the stipules, but by the hairs above-mentioned and the fine bases of the outer, older leaves, as well as the dead decaying leaves and stipules.

Nymphæa alba, Linn., agrees closely with *N. tuberosa.*

In *Nuphar* (*N. advena*, Ait.), on the contrary, there are no stipules, but the petiole is dilated into a membranous wing, which tapers upwards and thins gradually towards the margin. This sheath becomes gradually shorter in the younger leaves, till it forms a mere basal auricle. It assists efficiently in protecting the young leaves.

The stem-bud of *Victoria regia*, Hook., is covered with slime secreted partly by the stipules, partly by peculiar hairs on the leaf-surface (Goebel, Pflanzen-biol. Schilderungen, vi. Wasserpflanzen, vol. ii. p. 233).

CRUCIFERÆ.

Cardamine Impatiens, Linn.—The petiole is grooved from the apex to the base, which is dilated, and serves to protect the younger leaves. Some of the lower leaves have rounded and thickened auricles, which in the upper leaves become prolonged into subulate, obtuse, falcate auricles clasping the stem. These are often called stipules. They really correspond to the auricles of other Cruciferæ, which are continuous with the margin of the leaf.

In *Heliophila crithmifolia*, Willd., the stipules are subulate, glandular, and inserted on the very base of the petiole. The buds are protected by the dilated petioles.

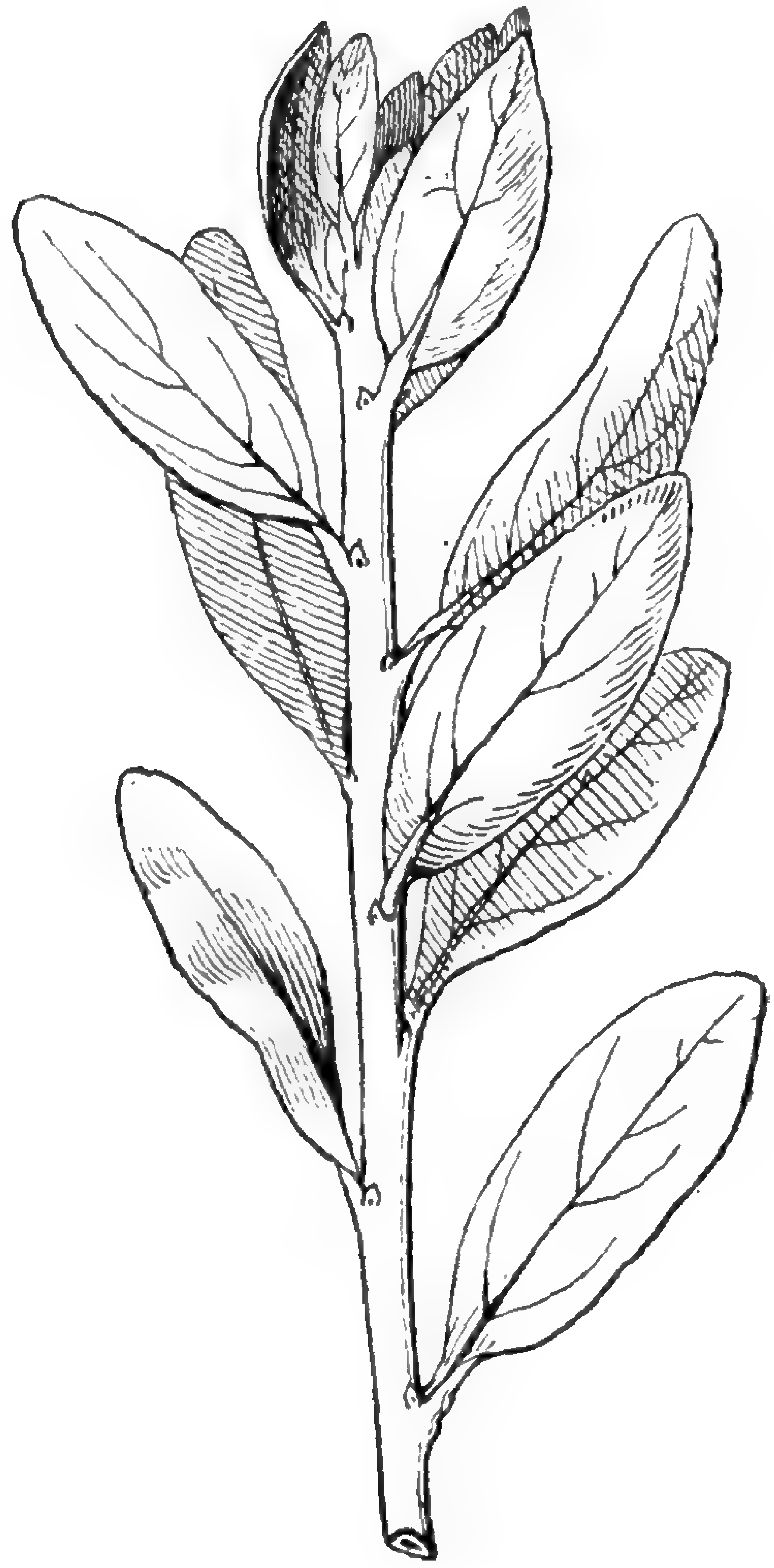
In *H. amplexicaulis*, Linn. f., the stipules appear to be entirely absent. The bud is protected by each pair of leaves in succession.

In *Iberis saxatilis*, Linn., the stipular processes are subulate, bristle-like, and inserted on the stem close to the edges of the leaf. The terminal buds are effectively protected by the crowded imbricate leaves. A similar arrangement occurs in many allied species. In *I. Garrexiana*, All., the stipules are also subulate, but apparently glandular. In *I. amara*, Linn., the petiole is winged for a great part of its length, but exstipulate.

VIOLAREÆ.

Hymenanthera is generally said to be exstipulate; but *H. crassifolia*, Hook. f. (fig. 2), has small, scarious, pale brown or grey, triangular stipules inserted on the slightly dilated base of the petiole close to, and even apparently on, the stem. They are ciliate at the margin, and are often torn. They are only 1 mm. long, and yet afford a considerable amount of protection to the young bud. Perhaps they may be very caducous and have therefore been overlooked.

Fig. 2.



Hymenanthera crassifolia, × 2.

PORTULACEÆ.

In ***Portulaca grandiflora***, Hook., the leaves narrow suddenly into a short petiole, furnished with numerous, woolly-like setæ. The setæ, aided by the crowded leaves at the apex of the stem and branches, effectively protect the bud.

In *Calandrinia umbellata*, DC., the leaves are crowded in dense fascicles and are narrowed downwards but not distinctly petiolate; the basal portion is again much dilated, with a broad insertion, and strongly ciliate with coarse hairs to the summit of the dilated portion or rather beyond it. There are no stipules.

Claytonia perfoliata, Donn, is also exstipulate, the petioles being greatly dilated and thickened at the base, with a membranous margin. The buds are effectively protected by the numerous dilated and imbricated petioles. Stipules are also absent in *Talinum.*

F. Pax in his account of the family in the 'Pflanzenfamilien' observes that the widely distributed metamorphosis of the stipules, in this family, to protective organs for the axillary shoot or the inflorescence, is, like the fleshy character of the leaves, closely connected with the habitat—the dry plains of the Karroo and California.

The stipules are reduced to axillary bundles of hairs not only in *Portulaca*, but also in *Talinopsis*, *Grahamia*, and *Anacampseros.*

TERNSTRŒMIACEÆ.

This order is generally exstipulate. For instance in *Eurya japonica*, Thunb., the leaves are without stipules, sessile, and convolute in bud. The oldest unfolded leaf is rolled round the bud, covering the whole except a small part which is protected by the next oldest leaf.

Even when stipules occur, they are generally small and caducous. In *Stachyurus præcox*, Sieb. & Zucc., they are subulate, carinate, slenderly acuminate, glandular, serrate, and 6–10 mm. long. They fall away as the leaves attain full size. They are inserted at the very base of the petiole or even on the persistent pedestal. The stipules of the first and second unexpanded leaves together almost cover the younger leaves.

In Engler and Prantl's 'Pflanzenfamilien' *Stachyurus* is placed in a distinct order *Stachyuraceæ*, and *Caryocar* similarly in *Caryocaraceæ*, so that Ternstrœmiaceæ proper (called Theaceæ) are exstipulate.

In *Caryocar nuciferum*, Linn., the stipules are much more developed, interpetiolar, and all four stipules of the opposite leaves are connate in two pieces, inserted upon the stem a little above the leaves to which they belong, completely protecting the bud.

MALVACEÆ.

In *Althæa Heldreichii*, Boiss., the petioles are terete, thickened at the base, with a prominent pedestal. The stipules are foliaceous, tolerably large, and more persistent than the leaves to which they belong, bifid at the apex, erect, and inserted on the pedestal on a level with the insertion of the leaf. The buds are thus protected by the erect stipules on two sides, and by the stem and petiole on the other two. The terminal buds consist of numerous leaves folded into a small space along the course of the principal veins, and of numerous stipules which equal the leaves in length; both leaves and stipules are very hairy, so that altogether the protection afforded is considerable.

Towards the apex of the stem the leaves become very much reduced in size, and finally disappear long before the stem has ceased to grow or produce flower-buds. The stipules remain and are connate into a 5–6-fid semiamplexicaul piece, supporting and protecting the flower-buds in their earlier stages. The latter are intensely downy.

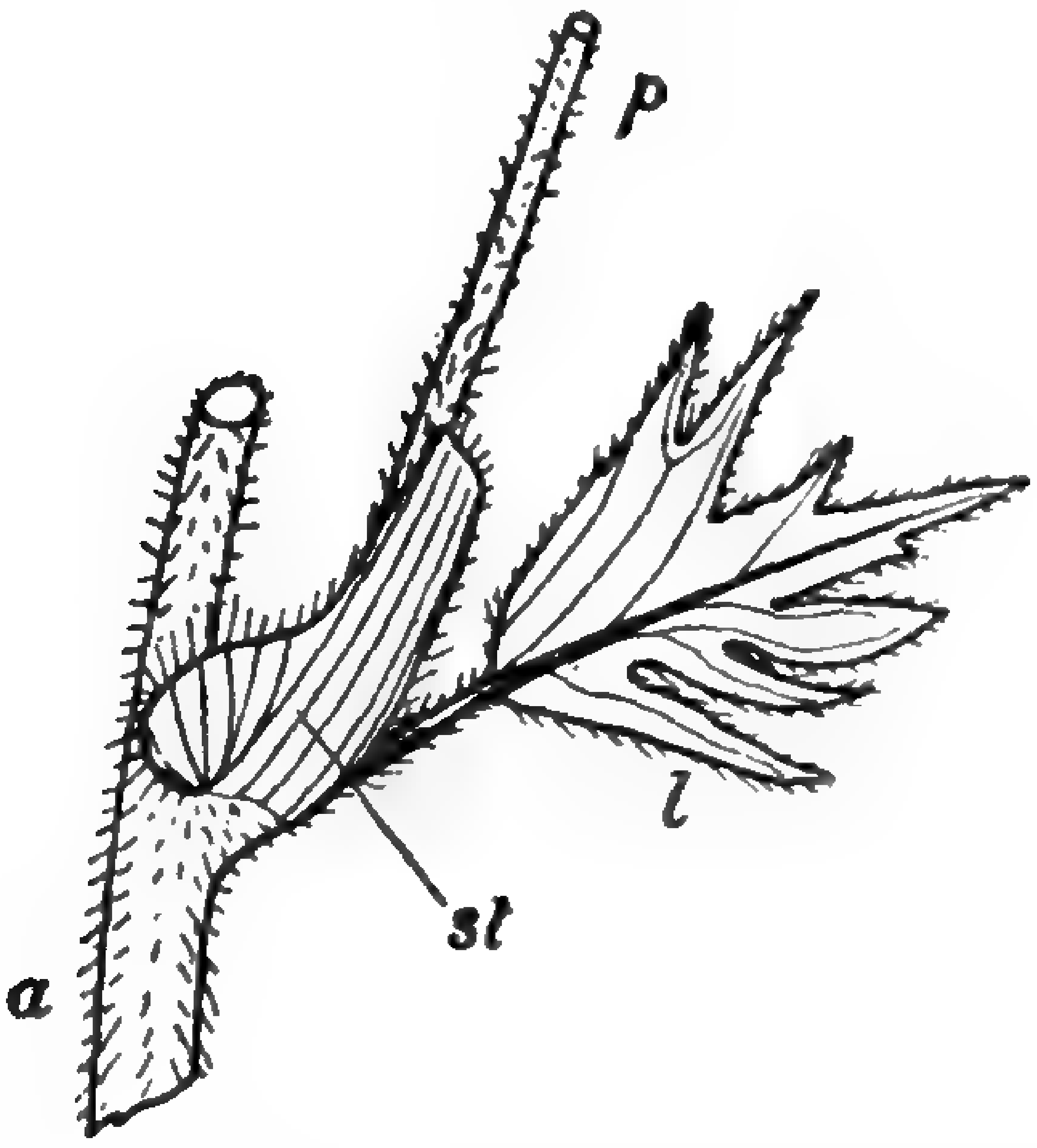
In *Althæa rosea*, Cav., the stipules are similar to those of *A. Heldreichii*. In *A. officinalis*, Linn., they are linear or subulate, entire, acuminate, or bifid, with unequal segments, and caducous.

In *Abutilon megapotamicum*, St.-Hil. & Naud., the stipules are ovate, acute, concave on the back when fully developed, unequal at the base, the side away from the petiole being the larger, and that next the petiole cut away; they are unequal in size, that on the upper side of the drooping branches being the broader and often the longer. They appear to be about as persistent as the leaves, and amply protect the terminal buds.

In *Sidalcea candida*, A. Gray, the large ovate green stipules cover the young leaves or inflorescence.

In *Callirhoë involucrata*, A. Gray (fig. 3), the leaves are 3–7-lobed or parted, with long or short petioles grooved on the upper side, slightly dilated at the base. The stipules are foliaceous, obliquely ovate, the lower ones generally entire with an auricle on the side next the axis, inserted with a broad base upon the stem and clasping the latter with its auricles, while the other edge overlaps and entirely covers its own petiole, although not adnate to it. Towards the apex of the flowering stem the leaves become smaller and finally disappear altogether. The stipules are, however, developed, and are connate throughout their length into one keeled piece erosely toothed along the apex. The internodes are very slightly developed here, so that the upper flowers appear crowded together in one involucrated raceme. Both terminal and axillary buds (the latter being flower-buds) are well protected here by the connate stipules. The axillary buds on the lower part of the stem mostly consist of a solitary flower, which is also protected in its early stages by the stipules, stem, and petiole of the leaf. In *C. pedata*, A. Gray, the stipules are similar, but apparently never connate.

Fig. 3.



Callirhoë involucrata, ad nat.—*a*, axis; *l*, uppermost perfect leaf; *p*, axillary peduncle; *st*, stipule still free, but the first pair above this connate.

STERCULIACEÆ.

Theobroma Cacao, Linn.—Leaves alternate, distichous, petiolate, stipulate, oblong-elliptic, thinly puberulous beneath when young, glabrous when old, coriaceous, persistent; petiole subterete or slightly flattened above, thickened at both ends. Stipules subulate, acute, green, finely puberulous, deciduous.

Terminal bud in the resting stage covered by three or four scales or reduced leaves, which are caducous. In the growing stage it is covered by two pairs of stipules, one pair belonging to an expanded and developing leaf, and the other to the leaf about to develop. The leaf in the bud state is folded together or subconduplicate, very narrow, and covered with hairs; it continues to increase in size long after it has unfolded.

The axillary buds are sheltered by the thickened base of the leaf and by the stipules, but they remain very small the first season and are covered by downy scales.

In the West Australian genera *Thomasia* and *Guichenotia* the stipules are generally foliaceous; in the latter often as large as the leaves.

Berrya Ammonilla, Roxb.—Leaves alternate, petiolate, stipulate, cordate, or the smaller ones oblong with a cordate base, 5–7-nerved at the base, irregularly dentate, membranous but persistent; petioles terete, slender, thickened at the base, elongated, pilose in their early stages. Stipules terete or filiform, slender, downy, inserted upon the axis close to the base of the petiole in their early stages, but ultimately removed from it a little way, deciduous.

Terminal bud covered by the leaves and their slender stipules. The lamina of the leaf is more or less involute at the margins. The stipules are as long as the leaves while the latter are in their early stages and sessile, but they protect only the spaces between every two leaves.

Axillary buds very small, and in their early stages nestling partly between a depression or cavity and the base of the petiole.

In the monotypic genus *Diplophractum*, from Java, the stipules are dimorphic. Both are leafy and bullate, but while one of each pair is bifid and bristly the other is entire.

Elæocarpus edulis, Teysm.—Leaves opposite, decussate, unequal, petiolate, stipulate, ovate-oblong, subcordate at the base, incurvinerved, pubescent on both surfaces, persistent; petioles short, slightly dilated at the base, convex above, and somewhat flattened towards the base. Stipules in pairs owing to the leaves being opposite (a rare circumstance in this genus), small, subulate, deciduous.

Terminal bud in the growing state consisting of strongly involute leaves, standing face to face over the younger members, but not in any way imbricate, densely hairy. The stipules occupy the space between the leaves where the latter are narrowed to the base, making the protection of the next growing pair complete.

Axillary buds often elongating, densely hairy in their younger stages, and protected by the stipules and the ascending petioles of the leaves to which they belong.

In the small genus *Vallea*, from the mountains of New Granada and Peru, the stipules are large and almost foliaceous, reniform in shape.

Ch. Brunner, in Ann. Sci. Nat. sér. 3, vol. viii. p. 356, on the buds and inflorescence of the Lime, discusses the stipular character of the bud-scales.

GERANIACEÆ.

This family differs considerably as regards stipules. Some are exstipulate. *Averrhoa Carambola*, Linn., for instance, is exstipulate; the leaves are conduplicate in bud, three of them covering the younger ones, which, moreover, are protected by long silky hairs.

In *Impatiens parviflora*, DC., the edge of the petiole is furnished with one or two stalked glandular processes of unequal size. It is also decurrent upon the stem, forming a slender ridge on either side, which also bears numerous, shortly stalked glands. These do not increase in number, so that they become gradually separated by the elongation of the stem. Those on the edges of the stem increase considerably in size, and appear to represent stipules such as those of *Fuchsia*, *Circæa*. The bud is protected by the short and stout bases of the leaves.

Whatever doubt there may be whether the term stipule can be applied to these glandular processes, some species of the genus *Oxalis* are certainly stipulate, though the stipules present considerable differences. The 'Genera Plantarum' does indeed describe the genus as exstipulate; and this is no doubt true of most species, perhaps, for instance, of all the South-African forms. On the other hand, our three British species, *O. Acetosella*, Linn., *O. corniculata*, Linn., and *O. stricta*, Linn., are all stipulate. The transition from exstipulate to stipulate species is very gradual. *O. purpurata*, Jacq., has subterete petioles, flattened above, and articulate with a pedestal, both the pedestal and the petiole being densely glandular and pubescent. The stipules or their representatives are completely adnate to the edges of the pedestal, and terminate abruptly so as to form a triangular tooth at the upper outer angle. They are membranous and sheath-like. At the close of the season's growth there are sometimes several imperfect leaves, and the sheaths in these cases become greatly expanded. They persist after their leaves have fallen, and, with the pedestals, completely invest the bud. In *O. floribunda* the arrangement as regards the bud is similar, but the points of the stipular sheath are rather longer.

In *O. corniculata*, Linn., the stipules are submembranous, strongly ciliate, and terminate abruptly at the upper end. They are folded round, and amply protect both the terminal and axillary buds. The terminal bud consists of several leaves folded one within the other, or within the stipules of one another. The leaflets are conduplicate and parallel, and by the circinate curvature of the petiole they are brought down and lie between their own stipules in their early stages. Each successive leaf behaves in the same way. The flower-buds are axillary and likewise covered by the stipules in their earlier stages.

In *Oxalis oregana*, Nutt., the arrangement is similar to that of *O. corniculata*, but the pedestals are larger and much dilated towards the base.

In *O. pubescens*, H. B. & K., the stipules are more prominent and well developed. They are aduate to the edge of the pedestal, membranous, hairy on both surfaces, colourless, and persist long after the leaves have fallen.

Irmisch, Th., in Bot. Zeit. 1874, describes and figures the stipules.

LINACEÆ.

In the small closely allied natural order Linaceæ stipules may be present or absent.

In *Radiola* absent.

In *Linum* absent or present as glands.

In *Reinwardtia* foliaceous, but often very small.

Trelease, in his Revision of the North-American Linaceæ (Trans. St. Louis Acad. of Science, vol. v. no. 1, 1887), uses the absence of stipules or the presence of stipular glands in his subdivision of the genus *Linum*.

SIMARUBEÆ.

In compensation for the absence of stipules the buds are scaly; petioles dilated at the base.

Picræna excelsa, Linn.—The leaves are alternate, petiolar, exstipulate, imparipinnate, coriaceous, glabrous, persistent, with elliptic leaflets of unequal size, the uppermost being the largest; petioles semiterete in the upper half, and shallowly grooved on the upper face, terete downwards, dilated and thickened at the base, thinly pubescent with adpressed hairs.

The terminal buds in the resting stage (in the specimen examined) were covered at the base of the petiole by one or two of the last developed leaves, of which one may have fallen away, leaving a persistent pedestal, and also by two or more leaves reduced to the condition of scales. The latter consists of the whole leaf in a sessile condition, having a trifid but very small lamina. The first and succeeding perfect leaves have conduplicate leaflets folded very compactly in front of the midrib. All leaves at this stage, whether perfect or otherwise, are covered with adpressed hairs.

The axillary buds are small, scaly, hairy, and rest in a slight depression between the thickened base of the petiole and the axis.

OCHNACEÆ.

In *Ochna multiflora*, DC., the petiole is very short, flattened on the upper side; the stipules are intrapetiolar, connate at the base, subulate, acute, quickly becoming brown and caducous. The growing bud develops rapidly, and the stipules fall away on the expansion of the leaves.

In *Gomphia salicifolia*, St.-Hil., the leaves are shortly petiolate; the stipules subulate, acuminate, slender, 8–13 mm. long, inserted upon the stem close to the edges of the petiole, connected at the base by an intrapetiolar rim, soon becoming reddish brown and dead, but persistent. They remain, indeed, even on the stems and branches when the lower leaves of the previous season's shoots have fallen. The terminal bud is completely enveloped by the convolute stipules of the last developed leaf. The axillary buds are protected in their earlier stages by the connate portion of the stipules, and further sheltered by the permanently erect free portions *.

MELIACEÆ.

In this order there are no stipules.

Carapa guianensis, Aubl.—The leaves are alternate, exstipulate, petiolate, equally pinnate, with 4–6 or more pairs of oblong, shortly petiolulate leaflets, glabrous, coriaceous, persistent; petiole long, terete, suddenly very much thickened at the base. Terminal bud surrounded by very much reduced and thickened scales, several of which appear little more than cortical outgrowths of the bark, so that the outer ones do not close over the top of the bud, which in the resting stage is extremely short, as in *Robinia Pseud-Acacia*. The axillary buds are minute, evidently seldom developed, as the plant is of stout habit and very little branched, resting in a small cavity of the axis, and partly surrounded by the base of the thick petiole.

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* Gilg, in his account of the family in Engler and Prantl's 'Pflanzenfamilien,' divides the genus *Ouratea* into two sections:—I. *Neo-ouratea*. Stipules lateral, not joined. American species.—II. *Palæ-ouratea*. Stipules more or less intra-axillary, joined but more or less deeply cut, often to the base. Old World species.

Cedrela sinensis, Juss.—The winter-bud is protected by four or five modified leaves, the first two of which do not elongate very much in spring, while the others become green, but fleshy and scarcely foliaceous. All five are broadly triangular and entire or slightly emarginate, or the fifth may have rudimentary leaflets. These are followed by two perfect pinnate leaves, which have broadly dilated bases with no trace of an axillary bud in the axil of either. Succeeding ones have a small axillary bud that is already well developed while the leaf is still quite young and unexpanded. This bud is protected to a great extent by an open cavity at the base of the petiole, as in *Rhus semialata*, Murr., *R. japonica* var. *Osbeckii*, *R. Cotinus*, Linn., and others. The bud likewise remains very small till the following spring.

The terminal bud is protected mainly by the broad bases of the petioles, which remain erect till the lamina has attained some size. It dies in winter, or is continued in spring with some difficulty, and is always later in commencing to develop than the lateral ones.

In *Chloroxylon Swietenia*, Linn., the paripinnate petiolate leaves are exstipulate, glabrous, persistent; leaflets in numerous pairs, small, oblong, entire, obliquely cut away on the posterior side towards the base; petiole slender, subterete, convex above, dilated and thickened at the base, thinly scurfy or pubescent, articulated with the stem, and green, while all beneath the articulation is brown.

The conical terminal bud is covered by three or more subulate, succulent, green and pointed scales; in any case three scales cover all the younger members, and some additional protection is afforded by the base of one or two of the last-developed leaves.

The axillary buds are very small, covered by two or more scales and closely protected by the dilated base of the petiole. During winter many of the leaves fall, leaving the buds unprotected otherwise than by the scales.

OLACINEÆ.

This order is exstipulate.

In *Villaresia grandiflora*, Fisch., the petioles are short and semiterete, not dilated, but grooved at the base; the axillary buds, which are small, nestle between the axis and the grooved petiole. The terminal bud is also small, and consists of a small mass of convolute leaves.

CELASTRINEÆ.

Euonymus radicans, Sieb. & Zucc.—The leaves are opposite and decussate, but all turned to the upper side of the creeping stems, and appearing distichous. In this case they are ovate, generally small; but on short erect and stiff branches they are large, lanceolate, regularly decussate, and stipulate. In the bud each pair completely covers the younger members; the individual leaves are concave or folded longitudinally so as to enclose the younger ones, and are half-equitant, narrowed to the base. The resting bud consists of six or seven pairs of leaves reduced to the condition of concave scales, more or less auricled at the base, and exstipulate. Sometimes the shoots assume a resting condition in summer, forming a bud protected by one or few pairs of scales.

The stipules are small, bi-tri-fid, membranous, colourless, and situated at the very base of the leaf, where it is narrowed away at that part which develops into the petiole. They soon become brown, fall away early; they are absent from the scales of the resting bud.

Axillary buds arise in the axils of the leaves, while the latter are still young and erect at the base, and are sheltered by their own scales, by the stem, petioles, and to a slight extent by the small stipules.

Catha edulis, Forsk., presents us with an interesting case of stipules of two kinds on one leaf.

The leaves are alternate, petiolate, stipulate, elliptic, or obovate-elliptic, serrate, coriaceous, glabrous, persistent; the petiole short, semiterete, rather deeply grooved above, prominently edged, scarcely dilated at the base, articulated.

The stipules are of two kinds. The outer set or true stipules are subulate, acuminate, ciliate, with a strong midrib, erect, adpressed to the axis, and having the anterior half lying in front of the petiole. They are semipersistent, but many of them fall during the first winter. The other set of stipules consists of coarse fringes or ciliæ, not unlike the ramenta of ferns, and are intrapetiolar, extending in front of the true stipules and the petioles. When the outer ones fall, the plant appears to possess these fringes only. The 'Genera Plantarum' says "Stipulæ e ciliis paucis," and seems to refer to these fringes only.

The terminal bud (at least in the resting stage) is completely covered by the true stipules, and further protected by the petioles of one or more of the last-developed leaves, which are either small or imperfect.

Cassine is said in the 'Genera Plantarum' to be exstipulate. *C. Maurocenia*, Linn., however, has small, subulate, acute stipules, glandular at the margin, erect, gummy in the young stage, 2–2·5 mm. long, soon becoming brown or black, but persistent.

The terminal bud in the resting stage is covered by scales or imperfect leaves, with stipules which persist after the imperfect leaves have fallen. It is also protected by the petioles of the last-developed pair of leaves. In the growing stage it is protected by the stipules and by the petioles of the youngest expanded pair of leaves, as well as by the developing pair when there are any in this condition.

RHAMNEÆ.

In *Zizyphus Jujuba*, Lam., the leaves are alternate, somewhat irregular at the base of the branches, but for the greater part distichous, petiolate, stipulate, oval, serrulate, 3-nerved, glabrous or thinly pilose beneath, persistent; petiole short, grooved above, not dilated at the base, hairy.

The stipules are spiny, unequal (that on the upper side of the shoots being the longest), straight, sharp, grey with a brown tip.

The terminal bud consists of involute leaves standing face to face, but touching one another by their edges only, and very hairy on the back. At this stage the stipules are erect, and occupy the spaces between the leaves; but they ultimately become spreading.

The axillary buds are very small, and nestle between the groove of the petiole and the axis.

The plant is evidently adapted for a dry climate and situation; and the stipules serve to protect it against browsing animals.

Zizyphus rugosa, Lam., has larger, roundly oval leaves. One stipule stands straight out at right angles to the axis, while the other remains nearly erect, but incurved towards the axis.

The terminal bud in the growing state is protected to a slight extent by their stipules, but more effectively by the tomentum on the underside of the leaves, and by the large size the latter attain before expansion.

In *Paliurus australis*, Gærtn., the stipules serve two purposes. They are spiny and dimorphic. On the strong upright young stems they are largest and longest, subulate, slightly decurved, and equal or nearly so. On the more slender lateral shoots with distichous leaves they are very unequal in size and dissimilar. Those on the upper side of the branches are the longer, subulate, long-pointed, straight, ascending in two ranks, one to the right and the other to the left, according to the side of the shoot on which it is developed. On the lower face of the shoots they are short, subulate, and decurved or hooked, and arranged in two ranks, as are those on the upper face of the shoots.

In the bud state they are erect, greatly elongated, in fact often longer than the leaves to which they belong, acutely pointed, but as yet quite soft. Their numbers would afford some protection to the leaves in the bud state, as the latter are crowded; but the chief object would seem to be that the straight ones protect the plants from browsing animals, while the hooked ones would not only answer the same purpose, but assist the plant to climb or scramble up amongst other bushes or shrubs.

In *Ceanothus rigidus*, Nutt., the stipules in the full-grown state are triangular, obtuse, short, stout, or thick at the base, rigid, pale reddish brown, persistent.

They attain their full size while still in bud, and while the latter is compact they equal the leaves in length. At this stage they are ovate and pointed; but as they get older the thinner and more membranous part becomes brown and falls away. They therefore serve to protect the young leaves in the bud state; and as the internodes become elongated a little behind the growing apex, they constitute a good protection to the axillary buds, which begin to develop at a very early stage of the growing shoot; in fact, they are almost coeval with the terminal bud, developing one or two pairs of leaves on very short shoots in the axils of the leaves of the primary axis, and then in the majority of cases become arrested, although a large number of them on the stronger stems elongate, forming branches.

SAPINDACEÆ.

The Sapindaceæ are generally exstipulate.

Paullinia forms an exception. The leaves are alternate, 3–4 times pinnate, petiolate, stipulate, evergreen, pubescent while unfolding, but afterwards glabrous, or nearly so, or sparsely pilose; petiole subterete, shallowly grooved above, densely pubescent with curled or hooked hairs; thickened, and pulvinated at the base.

The stipules are moderate in size, subulate, acute, pubescent.

The segments of the leaves are separately involute or imperfectly conduplicate, and, with the branches incurved, form a clavate mass. The stipules attain full size, or nearly so, in the bud, and occupy the space between the axis and each leaf.

Serjania contains some species which are exstipulate; but *S. Caracasma*, Willd., has small subulate stipules, which often persist after the leaves have fallen.

In the Maples, where stipules are absent, the bud is protected by scales which, as Goebel has shown, represent a broadening of the leaf-base with, at the same time, suppression of the upper part.

In *Melianthus major*, Linn., the leaves are imparipinnate, alternate, stipulate, with the leaflets more or less decurrent upon the midrib, especially the uppermost pair.

The stipules are large, foliaceous, adnate to the petiole for the lower half of their length or more, free from the petiole in the upper portion, but intrapetiolar and connate almost to the apex, which is bidentate, decurrent below the insertion of the petiole, adnate to the stem, amplexicaul, and connected at the base on the posterior side by a slight rim, glaucous, glabrous; the upper free portion is ovate.

These stipules do not protect their own leaf, but are completely rolled round all the younger members of the terminal bud, and even slightly overlap one another, as in *Leea coccinea*, Planch., and *Bucklandia populnea*, R. Br. Their being decurrent upon the stem enables them the more completely to enclose the bud. Their own leaf nearly attains full size before they themselves unfold. After they spread open they only afford partial shelter to the axillary bud, which receives some protection from a deep groove in the petiole, extending as far as the adnate portion of the stipule.

Staphylea pinnata, Linn.—The winter-bud is already well developed by the end of July, and is protected by two pairs of leaves reduced to the condition of scales, the outer pair of which are conduplicate over the bud, slightly imbricate, and each scale covering about half the bud. The inner pair are unequal in size, and each is involute so as to cover about three-fourths of the bud independently of one another, except that one is for the most part covered by the other.

The leaflets of the imparipinnate leaves are involute in the bud, forming linear-subulate pieces, and stipellate. The stipellæ occupy the spaces between the pairs of leaflets. The stipules are lanceolate or subulate, and similar to the leaflets except that they are merely concave (not involute), membranous and ciliate-serrate at the edges, with one half of each in front of the leaf, while the other halves occupy the rather wide interpetiolar spaces. They are as long as, or longer than, the next younger pair of leaves, and fold over them, thus protecting as well as filling those spaces over the backs of the next younger pair of leaves. They do not increase in size after the expansion of the leaves, but become brown and caducous.

ANACARDIACEÆ.

Rhus aromatica, Ait.—Leaves pinnately trifoliolate, alternate, or on the first two lateral shoots very frequently opposite, exstipulate. The petiole is dilated and concave at the base, enclosing and protecting the axillary buds, which are developed even in spring and early summer.

The leaves are sessile or subsessile in bud, hairy, and protect one another. The terminal bud dies in winter, so that all the young shoots next year are developed from the axillary buds.

The concave base of the leaf is persistent, the petiole becoming disarticulated from it in autumn. It swells up and forms a protection to the winter-bud, which has one or two imperfect leaves, but no true scale upon it. The edges of the concavity are pressed against the stem during the growing-period, completely covering the axillary bud; but in the following spring, after the leaf has fallen from it, an outgrowth is produced from the stem itself in front of the pedestal, and this rim, together with the pedestal, forms a lipped cup enclosing the buds just about to develop.

LEGUMINOSÆ.

In *Petteria ramentacea*, Sieb., the leaves are alternate, stipulate, digitately trifoliolate, petiolate, densely tomentose in the young state, and silky above, but subglabrous when mature.

The stipules, which have been described as small and obtuse or obsolete in the early stages of the growth of the leaves, appear to be entirely absent; but careful removal of the tomentum covering them as well as the petioles shows them to be small, intrapetiolar, and slightly connate in front of the petiole, completely covering the still minute axillary bud. The terminal bud of the elongating shoots in spring is protected by the numerous unfolded leaves, 3–5 of the older of which completely surround the younger ones, as well as the rudimentary flower-buds where such exist. All are likewise densely covered with a tomentum. Apparently all the terminal buds, whether they terminate in an inflorescence or not, die during autumn or winter; so that the young growths in the succeeding spring are lateral.

The leaves are deciduous, but their stipules are persistent, and swell up or grow to considerable size, becoming thick and fleshy. Every lateral bud is therefore completely covered and effectually protected by the pair of stipules belonging to the leaf of the preceding year. These stipules, as well as the persistent pedestal of the leaf to which they are attached, are densely lined on the inner face with pale-brown hairs like a thick fur, although glabrous and dull olive-green externally.

Furthermore, the stipules being slightly connate in front of the petiole, the scar of the fallen leaf gives the impression that the latter was inserted on the back of the stipules.

In *Caragana arborescens*, Lam., the stipules are variable; but those of the leaves on the elongated branches are subulate, spinescent, and adnate to the much dilated and semiamplexicaul, persistent pedestal of the leaf, which has a narrow membranous margin. The winter- and terminal bud is protected by numerous much-dilated, membranous, emarginate or bifid scales, which are really the modified pedestals with the free lobe or teeth representing the stipules. The latter in this case are not spiny. The lower internodes of the axis proceeding from this bud are not developed, and the crowded bases have oblong membranous scales with a thicker and darker midrib, but entirely without spines.

The axillary buds are protected by one scale like that of the terminal winter-bud, and by one or two perfectly developed leaves having short, subulate, spiny stipules.

There are therefore three kinds of stipules: namely, the short membranous ones like teeth surmounting the scales of the winter-bud; the oblong, elongated, and membranous ones of the crowded or fascicled leaves; and the subulate spinescent ones of the leaves on the elongated shoots. The first two kinds protect the winter-bud and the base of the summer growth respectively; but the pedestals to which they are attached play the most important part of this duty on account of their much greater size. The spinescent stipules are soft when quite young, and assist in protecting the growing bud; but as they become spiny, their object is obviously to protect the plant as a whole from browsing animals.

In *Lathyrus Clymenum*, Linn., the first three leaves of the seedling are small, scale-like, ovate, acute, sessile, and semi-amplexicaul, with the stipules represented by a small tooth on each side. Those of the first leaf are above the middle; of the second leaf at the middle; and of the third leaf below the middle. Strong axillary buds are produced in the axils of these leaves.

The fourth and succeeding leaves are distichous, as well as the first three; but they are lanceolate, acuminate, and without apparent stipules, carinate beneath, with three or four nerves on each side of and parallel with the midrib, ending in a small auricle or blunt tooth at the base, and then decurrent upon the stem, forming two wings with a ridge between them on the other two faces. The leaves are convolute in bud, enclosing all the younger members, and not expanding till they attain considerable size. The basal auricles facilitate the folding.

These wings are evidently winged petioles, without leaflets, and the stipules wholly adnate to them, with exception of the basal teeth, which would appear to represent the auricles of the stipules met with in other species. All the lateral nerves of the leaf arise from a short one which curves outward and downward from the base of the leaf, and runs down the margin of the wing of the stem.

Bentham, "On the Mimoseæ," Trans. Linn. Soc. xxx., refers to the stipules; on p. 341 he says, spinescent stipules are met with in various groups, especially in the Acaciæ Gummiferæ and Pulchellæ, and a few Phyllodineæ and others, and, as far as has been observed, are always independent of physical conditions. In the Acaciæ Gummiferæ, whether from tropical America, Africa, or Asia, they offer the curious phenomenon of an extraordinary development of some of the pairs, or sometimes of nearly all of them, assuming the aspect of horns of cattle. Such horn-like enlargements are most general in dry hot regions; but, as far as the information of collectors can be relied on, many of the specimens thus affected are from the richest moist forest-regions of tropical America. They never appear to affect the whole of the stipules of any one bush, varying in degree of development in the several pairs of stipules of the same branch, but affecting special forms and tinges of colour, from an ivory-white to a livid purple, for each species. They are generally hollow, with a small opening, and in America at least are usually tenanted by colonies of stinging ants (as in the case of the common bull's-horn Acacia) (see Belt's 'Naturalist in Nicaragua,' p. 218).

The "stipellæ" sometimes present at the base of the pinnæ of a compound leaf, Bentham uses as a serial character in his subdivision of the genus *Mimosa* (*l. c.* p. 389).

In *Crotalaria* the presence or absence of stipules, their shape and position are of systematic value in the subdivision of the genus. In one series they run down the stem, forming wings as in *C. stipularia*, Desv.

In *Oxytropis* union with or freedom from the leaf-stalk serves the same purpose.

In *Machærium*, a large tropical American genus, the stipules are often converted into thorns, which may be bent backwards to aid the plant to climb (see Schenck, 'Beiträge zur Biologie u. Anatomie de Lianen').

Urban, in a monograph, "Morphologie der Gattung Bauhinia," in Bericht deutsch. Botan. Gesell. iii. (1885), says:—"The stipules are always present by the insertion of the leaf, and completely free from each other and the petiole. It is worthy of mention that in the climbing species of different sections they are almost always tolerably broad, in the remainder generally linear-subulate." Intrastipular thorns also occur, arising from intrastipular trichomes. Such are found also in *Olneya*.

Bower (on *Humboldtia laurifolia*, Vahl, in Proc. Phil. Soc. Glasgow, xviii. p. 324) describes the peculiar stipules in this myrmecophilous plant. They consist of two parts—a lower sagittate part with 4–6 glands on its upper surface, and an ovate-lanceolate part with one or more glands on the lower surface; they originate from only two outgrowths at the base of the leaf-stalk before the pinnæ.

ROSACEÆ.

In my previous paper I have already alluded to various interesting cases presented by species of this order. To these I have now several additions.

In *Prunus prostrata*, Labill., the stipules are slightly connate, converging, intrapetiolar, fringed. Stipules inserted on the pedestal of the petiole only, then coming in front of the latter they unite with one another, and are therefore practically intrapetiolar; they are connate for a little way only, and then run out into two slender, erect, acute, linear, and more or less glandular filaments 4–7 mm. long. In the rounded sinus of the fork the glands are more or less developed into slender teeth; on the lateral and free side of each they are more or less pronounced, and one of them (seldom more) runs out into a slender filament 1–3 mm. long. This filament recalls the lateral and basal spur or branch of the stipules in *Lathyrus*, and either extends at right angles to the main body of the stipules or is clasped round the stem.

The object of these peculiar, intrapetiolar, and connate stipules is evidently for the protection of the axillary buds which they closely invest. They are also closely lined with silky hairs on the inner face; and the lateral filaments or spurs, when rolled round the shoot, seem designed to assist in holding the stipules in position. The stipules as a whole are more persistent than the leaves to which they belong; and as the petiole becomes disarticulated at the point where the stipules cease to be adnate to the pedestals, the leaf appears at first sight to be an outgrowth from the back of the stipules. All these facts point to the conclusion that the object of the stipules is to protect the axillary buds, which are well developed even on the young and still growing shoots.

In the young state the free edge of the stipules below the lateral branches is distinctly glandular and serrate. As the terminal bud is approached, the sheath and glandular serratures are relatively very large, and render material service in protecting the terminal bud, while the lateral ones at this stage are not yet evident. The lateral tooth, designed to lengthen into the branch or filament above mentioned, is short and erect at this stage. The leaf is sessile or nearly so, compactly conduplicate, and lies between the stipules with its edges to the axis.

The stipules appear to be distinctly intrapetiolar even in the earliest stages, as far as the connate portion is concerned, the free portions being right and left of the lamina. The latter is strictly conduplicate at a very early stage, and considerably longer than its stipules.

In *Prunus domestica* (var. *œconomica*), Linn., the stipules of the elongated shoots are lanceolate-linear, acuminate, glandular-ciliate, with a lateral slender lobe near the base on the posterior side, inserted on the pedestal below the insertion of the leaf, and not adnate to the petiole, 5–8·5 mm. long; the lateral lobe proceeds nearly at right angles from the main body of the stipule, curves round the stem, and measures 1–3·5 mm. long. The young axillary buds are well protected by the base of the petiole and the stipules. The lateral lobes and the glandular-ciliate stipules may be compared with those of *P. prostrata*, Labill., from which they differ, however, in not being intrapetiolar nor connate.

In the bud the stipules assist in protecting those portions of the terminal bud where the lamina of the leaf narrows into the short petiole; the lateral lobes are ascending at this stage of their growth and relatively short.

In *Rubus australis*, Forst., the stipules are minute, sometimes wanting, while the leaves are reduced to midribs with linear leaflets.

The stipules are seated on the upper edge of the pedestals, small, subulate, almost filiform, elongating as the leaves attain a greater size, and sometimes wanting; they resemble a colourless gland in the earlier stages, and ultimately disappear. Like the leaves, they seem to be reduced to a mere rudiment or a remnant of what they have been in the ancestral form of the plant, in order to accommodate themselves to a dry climate. Stipules generally seem to be less necessary under such conditions.

In winter, the leaves exhibit no evidence of stipules.

In *Geum rivale*, Linn., the stipules are of two forms. Those of the radical leaves are of considerable length, and as a rule entirely adnate to the dilated grooved petiole, forming a membranous, colourless, ciliate margin, tapering into a petiole at their upper end, and sheath-like. Occasionally one of them is free at the upper end, and subulate and foliaceous.

The stipules of the cauline leaves are foliaceous, but small and incised like small segments or leaflets, and semiamplexicaul. The lower ones are adnate to the petiole for more than half their length, the middle ones for one-third, and the uppermost ones on the small leaves or bracts for two-thirds. The lamina of the latter is linear, and very much smaller than the stipules.

In *G. urbanum*, Linn., the stipules of the radical leaves are apparently always adnate to the dilated grooved base of the petiole, red or pale green, and more resembling a sheath than in the case of *G. rivale.*

Those of the cauline leaves are very large, foliaceous, cuneate, serrate or lobulate, and serrate along the upper end, narrowed to the base, and adnate to the petiole by their narrow base only. They are often larger than the lateral leaflets or segments of the lamina, and on the uppermost leaves larger than any of the segments of the lamina. Besides performing the usual function of stipules in the protection of the terminal and axillary buds, they likewise act as supernumerary leaflets, and might practically be regarded as small leaves.

Rubus rhamnifolius, Weihe & Nees.—Leaves alternate, petiolate, stipulate, digitate, with 3–5 cordate subtomentose and glandular leaflets; petioles grooved above, dilated and thickened at the base, aculeate, hairy and glandular.

Winter-buds mostly lateral, covered with scales. The progressive forms of the stipules may be seen by examining the young shoots when 2–3 cm. long. The outer scales are short and seem to consist of the base of the petiole with the stipules combined. A few of the innermost scales are ovate, elongated, and trifid, the lateral teeth or lobes being stipules. One or two perfect leaves with three small leaflets and subulate stipules follow; the stipules become free at or above the middle of the petioles. Succeeding leaves are much larger, with lanceolate or linear-lanceolate, foliaceous, subtomentose stipules.

The growing bud is made up of numerous leaves, with conduplicate leaflets again strongly plicate along the course of the lateral nerves. The three central leaflets are nearly parallel; but the lateral pair are slightly in front of the terminal one. The basal pair are folded and imbricate over the face of the middle pair. The stipules are narrow, but nearly of their full length, though shorter than the leaflets, and occupy the space between the leaf and the axis. The protection they afford is only partial, and the tomentum on the back of the leaves must assist considerably.

The axillary buds are amply protected in their early stages by the dilated base of the petioles and the stipules; the latter are, however, too high up the petiole to be of much service, so that the terminal or growing bud is most benefited by them.

R. suberectus, Anders.—Five or six of the larger and more elongated scales of the winter-bud are tridentate or trifid, but shorter than those of *R. rhamnifolius*. One or two small, but otherwise perfect leaves follow, and have triangular or ovate stipules inserted not far from the base of the petiole. The succeeding leaves are full-sized, with lanceolate, then linear-lanceolate stipules, free almost to the base of the petiole; they protect more of the growing bud than in *R. rhamnifolius*, owing to the axis being thinner and the bud smaller.

The axillary buds are protected by the base of the petiole, which long remains erect or sharply ascending. The stipules also render more assistance in this case, as they bridge over the space between the petiole and axis, and being more or less rolled round they cover a considerable portion of the latter.

Stipules of two or three forms.

Potentilla simplex, Michx.—Winter-bud subterranean, covered by several broad or dilated tridentate scales, consisting of the petiole and the adnate stipules. The middle tooth is frequently tridentate, representing the lamina, in which case the scales consist of the whole leaf modified.

The stipules of the radical leaves are membranous, adnate to the dilated base of the petiole for two-thirds of their length, and clasp the bud, with narrow, free, apical portions.

The cauline leaves have much shorter sheaths and the stipules are more or less connate at the base, forming a cup round the axis. They are adnate to the petiole for one-third to one-half their length. The middle cauline leaves are often opposite and connate at the base in a decidedly cup-like manner. The upper cauline leaves are often reduced to a simple leaflet, with their stipules, in which case the stipules are more foliaceous and often as large as the solitary leaflet.

The hibernating buds are mostly, if not all, axillary, and are covered by numerous pairs of leaves (apparently in their entirety) reduced to decussate imbricate scales. The lamina is represented by 1–3 or more apical teeth; and the stipules are reduced to a small tooth on each side of the scale some distance above its base. The buds are therefore well protected. The stipules, though potentially present, are functionless.

Alchemilla alpina, Linn.—Stipules 1–2 cm. long, adnate to the petiole for the greater part of their length, and connate almost throughout along their posterior edges, where they are merely emarginate, the upper third of their length being intrapetiolar; covered with adpressed silky hairs, as are the stems, petioles, and underside of the leaves. They thus form a long sheath enveloping the short stems, whose internodes are but slightly elongated, and amply protect not only the terminal bud, but the axillary ones, which are very freely produced. As the main axis thickens and the axillary buds elongate, the stipules split regularly or irregularly throughout their length along their posterior edges, and frequently the anterior edges likewise as far as the petiole, but still remain attached to the latter. The first pair of stipules on the axillary branches are precisely like those on the main axis, but they have no trace of lamina nor petiole in the sinus. The axillary branches bear the flowers, and their upper stipules are shorter, with the free portion foliaceous and deeply incised along the upper edges, as well as more deeply cut on their posterior edges.

In *Pyrus baccata*, Linn., var. *microcarpa* the stipules are persistent and heteromorphic. On the elongated and strong-growing shoots they are lanceolate, acuminate, serrate, foliaceous, shortly petiolate or stalked, adnate but a short way to the side of the short dilated base of the petiole, and having a very much smaller lobe on the posterior side of their stalk. These small lobes are more or less completely cut down to the petiole of the stipule, or they may even have a short stalk of their own. Near the base of the shoot the stipules fall away much earlier than their leaves. They measure from 1·4–3·2 cm., the largest being towards the top of the shoot, and their lateral lobes vary from 1·5 mm. to 9·5 mm. in length.

At the base of the moderately long, spur-like shoots the stipules are small and tooth-like. A little above this they are subulate, acuminate, and fall early. Those of the uppermost leaves are adnate to the base of the dilated or sheathing portion of the petiole for a distance of 3–4 mm., and the free portion is linear, slender, almost filiform, but a little dilated above the middle, and slightly glandular-serrulate.

Very short spurs or shoots about 2·4 cm. long have less developed stipules. The lowermost ones are tooth-like, with generally prominent glands. The uppermost ones are comparatively broad, but adnate to the petiole for the greater part of their length, forming a sheath ciliated at the edges and protecting the terminal bud; the free portion is tooth-like or ovate, according to its size, gradually becomes brown, and falls away before the leaves.

The two outer scales of the winter- or resting-bud are roundly ovate, tridentate, and cover about half the bud; the middle tooth is truncate and represents the base of the petiole. The third scale has the middle tooth pointed; the fourth and fifth are closely ciliated at the edges and each covering two-thirds of the bud, but otherwise similar to the previous one. The sixth and seventh scales are trifid, each covering three-fourths of the bud, with the stipules broader than the middle tooth. The eighth and later ones are much narrower, tripartite, with a very short sheath, loosely arranged around the central axis and constituting true leaves. The stipules vary from ovate to subulate, and are about equal in length to the middle division, which is conduplicate and represents the lamina. In the younger leaves the lamina is rather longer than the stipules, and glabrous or nearly so, while the stipules are hairy.

The stipules of the species of *Pyrus* are generally deciduous and less persistent than the leaves; but those of *P. Aucuparia* as well as *P. baccata* var. *microcarpa* persist as long as the leaves themselves, at least on the strong and elongated, leafy and barren shoots.

In *Pyrus Aucuparia*, Gærtn., the stipules of those shoots are adnate to the petiole for about half their length, forming a broad sheath. The free portion is dimidiate, leafy, semiorbicular or semiovate, dentate, and somewhat spreading. They serve to protect the axillary buds, at least in their early stages, and the terminal bud while in the growing stage of the shoot. The stipules of the uppermost leaf of the same shoot are similar to, but smaller than, the others, or the free portion may be ovate, acute, and finely serrate.

Even as early as August the buds for the succeeding year's growth are well-developed. In a well-developed terminal bud (a flower-bud) the outer scale, which encloses a considerable portion, is short, truncate, and consists of the dilated base of the petiole combined with the adnate portion of the stipules, the lamina of the same being wanting.

The second scale is 11 mm. long, more pointed and emarginate, the points representing the free portion of the stipules; the third and fourth scales are as long, but tipped by the densely tomentose arrested lamina of the leaf. The fifth to the seventh inclusive consist of well-developed leaves; the stipules are half-ovate, finely crenate on the posterior edge, acute, and appear like the lowermost pair of leaflets, but differ in being flat and thinly hairy on the back. The sheath is greatly reduced in length. The leaflets of these leaves are closely conduplicate, compactly imbricated, and densely covered all over with long silky hairs.

In the axils of the true scales is a dense fringe of linear yellowish glands exuding a viscid juice. They are not confined to this position on the true leaves, but occur also at the base of each leaflet. They are greatly elongated, drawn out to a fine point, and feathery in the upper portion, like the tailed achenes of *Clematis* and some Anemones. These glands, since they exude a liquid, would be of a protective nature like those of the buds of the Horse-Chestnut.

The eighth leaf is very much smaller and less perfectly developed than the previous three, and a few of those that follow form small leaves at the base of the principal branches of the inflorescence. The rest are bracts at the base of the smaller branches of the inflorescence, and fall early.

The stipules above described on the flowering shoots remain small, ovate or subulate, become brown and withered up, and generally fall before August.

In *Cratægus Oxyacantha*, Linn., the stipules on the leaves of the short lateral spurs and those at the very base of the elongating shoots are minute and tooth-like, or subulate, soon becoming brown and falling early. Those on the elongating shoots vary from unilateral, falcate, serrated, small, but foliaceous organs, to large, half-cordate, simply or doubly serrate, shortly stalked, foliaceous, much reticulated organs, with the principal nerves radiating from the base of the lamina and passing into the principal teeth. Thus there are at least three distinct types of stipules.

Exochorda grandiflora, Lindl., as already mentioned (Journ. Linn. Soc., Bot. xxviii. p. 231), is exstipulate, though the scales of the winter-buds are tridentate at the apex, representing perhaps the petiole and stipules. On the other hand, in *E. Alberti*, Regel, the leaves have well-developed foliaceous stipules, which are obliquely oblong, often or always unequal in size, almost dimidiate, with the midrib or principal nerve marginal on the lower half of the anterior side, and a short distance within the margin in the upper half and excurrent at the apex, forming a short tooth. Their texture and colour is the same as that of the leaves. Their position on the petiole varies; sometimes they are close to the base, while at others they are very near the lamina. Some leaves have stipules on one side: they appear therefore to be derived from the lamina rather than from the sheath. The stipules of this genus therefore differ much from those of other Rosaceæ.

Rosa simplicifolia, Salisb., has no stipules, but the petiole has a thin margin, continuous with the lamina and dilated at the base where it protects the axillary bud. It is, however, never separated in any way from the petiole. There are one or two short capitate glands on each edge. There are no other glands on the leaf except at the tips of some of the teeth. Dr. Masters, however, informs me that the fibrovascular bundle intended for the stipules still exists, indicating that they existed formerly.

SAXIFRAGEÆ.

In this family the shrubby species are generally without stipules. In *Brexia*, however, though it is generally described as exstipulate, the leaves while in the bud have fairly developed stipules. They are triangular-subulate, but too small to afford much protection. In *Davidsonia pruriens*, F. Muell., the stipules are much larger, reniform, sessile, doubly incise-serrate and hairy like the leaves, and afford substantial protection to the young bud.

Wiesner, in his 'Biologie der Pflanzen,' gives a good figure of bud-protection in *Philadelphus Coronarius*, Linn. The axillary bud is protected by a portion of the leaf which remains after leaf-fall and forms an almost closed chamber (p. 41, fig. 30).

CRASSULACEÆ.

The buds are well protected by the bases of the thick sessile leaves.

HAMAMELIDEÆ.

I have already * described the large ovate stipules of *Bucklandia*. Those of *Liquidambar formosana*, Hance, are very different, being subulate-linear, acuminate, slender, ciliate, inserted on the edge of the petiole at the base of the latter in the early stages, but ultimately carried a little way above the base by the elongation of the petiole and extending to the base by a very narrow rim.

The leaves are alternate, palmately 3–5-nerved and lobed, serrate, hairy on both surfaces and folded along the principal nerves when in bud, ultimately glabrous or nearly so; the petiole is subterete, dilated at the very base, shallowly ridged and furrowed, the groove on the upper surface being slightly more defined.

The terminal bud in the growing stage consists of numerous leaves neatly folded up as stated above. The older protect the younger and the stipules also assist. They are about half as long as their own leaf while that is still sessile or subsessile, but as long as the next younger leaf, the edges and more tender parts of which they protect.

The axillary buds arise close to the apex of the axis and are covered by the still erect and dilated base of the petiole and by the stipules. They become more exposed when older.

Disanthus, a monotypic genus from Japan, has also linear stipules, while in the allied genus *Rhodoleia* they are absent.

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* Journ. Linn. Soc., Bot. xxviii. p. 238.

HALORAGEÆ.

This order is said to be exstipulate except in the case of *Gunnera*, where the stipules * are adnate to the petiole. In *G. scabra* there does not appear to be anything like true stipules, but the crown of the plant is furnished with numerous scales similar to those of many ferns, but variously and deeply lacerated, with strong branching ribs corresponding to the divisions. They seem to be irregularly arranged round the crown or bud which they cover, imbricating and forming a shortly conical mass. They persist after the leaves have decayed, and protect the bud in winter. As they are attached to the rootstock below the insertion of the leaf, they appear to belong to the former and lie in front of the petiole as well as behind it, but are not distinctly attached to either surface.

COMBRETACEÆ.

Quisqualis indica, Linn., is exstipulate. The lateral buds nestle in the axils of the petioles, and are densely hairy. The first leaves are almost reduced to bracts.

ONAGRARIEÆ.

The Onagrarieæ are generally said to be exstipulate †. I have already (*l. c.* p. 240) described the stipules in *Fuchsia excortica*.

In *Fuchsia Riccartoni*, Hort., the leaves are opposite or three in a whorl, subsessile in bud, afterwards petiolate, stipulate, articulated with a pedestal which in an early stage of the growth of the shoots becomes fleshy and much swollen. The stipules are small, subulate, acuminate, with an ovate base which is persistent and fleshy, while the slender tip soon falls away. They are inserted upon the pedestal and occupy the space alongside of the short young petiole. At this stage they protect the axillary buds, which are very advanced, and also to some extent the terminal bud.

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* Petersen (Engler & Prantl, 'Pflanzenfamilien,' iii. Teil, 7 Abth. p. 227) says:—"In *G. chilensis*, Lam., the stipules are numerous in the leaf-axil, and are arranged in several rows before the leaf-base; in *G. magellanica*, Lam., they form an ochrea."

† Raimann, who describes the family for the 'Pflanzenfamilien,' says:—"Stipules are absent in most Onagraceæ. *Fuchsia*, *Hauya*, and the *Jussiææ* have small, subulate, deciduous stipules, as also has *Circæa*" (iii. Teil, 7 Abth. p. 201).

Jussiæa is also stipulate.

In *Jussiæa acuminata*, Sw., the leaves are narrowly elliptic, alternate, stipulate, tapering to a petiole-like portion, which is narrowly winged to the base, so that the leaves may practically be considered as sessile. The stipules are subulate, acute, 0·5–1 mm. long, tumid at the base, green with a black tip, soon becoming entirely black, and possibly glandular, inserted on the persistent pedestal of the leaf and remaining even after the latter has fallen.

The terminal buds are protected by the leaves, which are quite sessile at this stage, and firmly convolute from the edge to the midrib, linear, and crowded in a small cone. The stipules occupy the space where the leaf is much narrowed at the base, and would assist to a small extent in protecting the younger members of the bud. The axillary buds on the upper part of the shoots are developed early, and are protected by the base of the leaf before this fully expands.

In *Circæa Lutetiana*, Linn., the leaves are opposite, decussate, with petioles dilated at the base and connected by a transverse rim, stipulate. On the subterranean nodes the leaves are reduced to short triangular scales, and their stipules to small glandular points, or they are inconspicuous. The stipules of the first and second node are scarcely larger. Those on succeeding nodes are subulate, acuminate, with slender points, but still comparatively small, and all are inserted upon the edge of the transverse rim connecting the petioles.

In the very young bud the stipules are well advanced and lie between the edges of their own leaves and against the back of the next younger pair, which they equal in length. This is the only stage where they may be said to afford any protection to the terminal bud. When the leaves get to some size the stipules lie against the back of the petioles of the next younger pair. The leaves attain some size before expansion and the older protect the younger. The stipules appear to be of glandular origin and resemble those of *Fuchsia excortica*, *F. Riccartoni*, &c. Axillary buds are protected by the dilated base of the petiole.

In *C. alpina*, Linn., the stipules of the two lowest pairs of aerial leaves are very small and glandular; those of the two succeeding pairs form larger glands. Sometimes the subterranean ones equal in size those of the upper cauline leaves, and in such cases they are tipped with a capitate gland. The rest resemble or agree with those of *Circæa Lutetiana.*

TURNERACEÆ.

In *Turnera aurantiaca*, Benth., the leaves are alternate, stipulate, oblong, regularly incurvi-nerved, subcoriaceous, covered with adpressed hairs in their younger stages, glabrescent as they become fully developed; the petioles are short, terete, slightly dilated at the base and articulated with a slight pedestal on the stem, and furnished with two large glands a little below the base of the lamina. The stipules are small, subulate, hairy like the leaves, and caducous.

The terminal bud is covered by three leaves, which are conduplicate, slightly imbricate, and finely plaited along the course of the incurved lateral nerves. The stipules do not occupy the sinus between their own leaf and the younger ones, but lie over the latter, and being small, can afford but little protection. Axillary buds are somewhat sheltered between the stem and the petiole, but are more efficiently protected by their own covering of hairs.

Turnera ulmifolia, Linn., var. *elegans*, Otto, has the leaves lanceolate-elliptic, alternate, tapering into the petiole, pubescent above and on the nerves beneath; petiole short, slender, biglandular in the middle, densely pubescent, very slightly dilated at the base. I could see no stipules.

The terminal growing bud consists of numerous leaves folded along their middle and involute at the edges, and standing erect round the younger members, thus protecting them. They attain considerable size before expanding. Their petioles and principal nerves are densely covered with an adpressed pubescence, which in itself must afford a considerable amount of protection. At the very base of the petiole, on each side of it, is a denser tuft of longer hairs in the position where stipules should be, and as is the case in *T. aurantiaca.*

The axillary buds are also protected in their young stages by the petioles and the clothing of hairs already mentioned.

FICOIDEÆ.

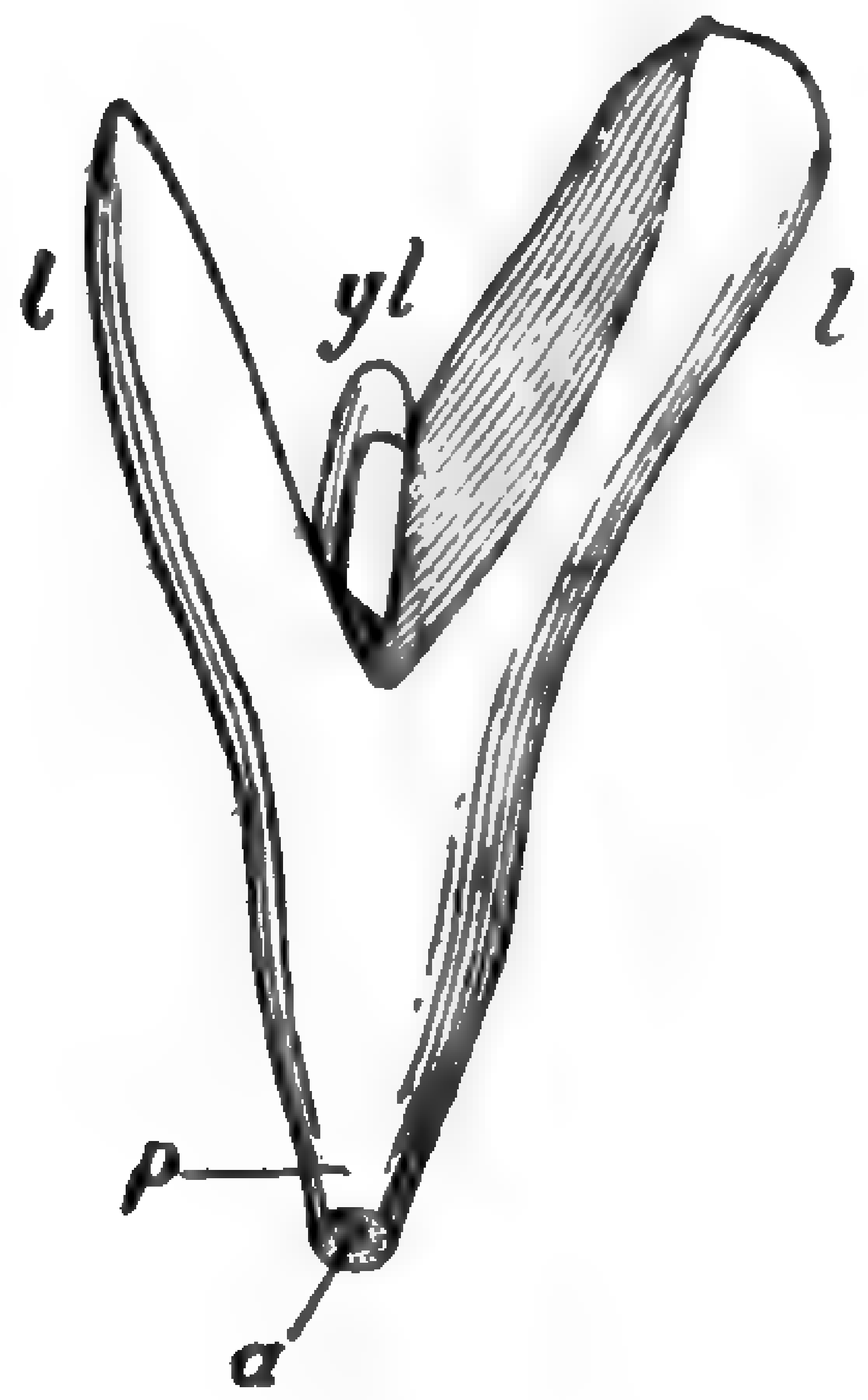
In *Tetragonia crystallina*, L'Hérit., the leaves are broadly ovate or triangular, fleshy, alternate, exstipulate, petiolate, densely covered on both surfaces with sunk gland-like globules of watery tissue, and in the young state bearing raised bodies of the same nature. The broad petioles are grooved above, slightly dilated at the base, and decurrent upon the stem, forming shallow ridges; the lamina is also decurrent upon the petiole.

The terminal bud is conical, strongly angular, and protected by three or four leaves that are concave at the base and slightly revolute at the edges, but otherwise nearly flat, and sessile or subsessile.

There are three axillary collateral buds placed antero-posteriorly. A solitary flower-bud lies next the stem, and in the middle is a leaf-bud well advanced; a second leaf-bud arises in front of the latter and close to the petiole by the groove of which it is partly protected. It arises at a considerably later period than the other two that are already well advanced and protected by the leaves of the terminal bud while they are still erect. The whole conformation of the plant with its fleshy, crystalline leaves and fleshy stems is evidently intended as a safeguard against drought.

Mesembryanthemum blandum, Haw., has the leaves opposite, triquetrous, 3–5 cm. long, rounded on the dorsal edge, very shallowly grooved on the upper surface, more decidedly so at the base, and connate there, forming a sheath 3–4·5 cm. long, which

Fig. 4.



Mesembryanthemum multipunctatum, ad nat.—*l*, *l*, pair of leaves connate, and sheathing in their lower half; *p*, from this point to the base the leaves are attached to the axis, and axillary buds arise exactly at this place; *a*, axis; *yl*, next younger pair of leaves.

remains green after the stem it encloses has become ripened and brown. The middle line of the sheath, that is the line of junction of the two sheaths, becomes brown with age while the thicker portion is still green.

Besides the sheath, the terminal bud is protected by the leaves remaining erect and closely compacted together till they attain considerable size, and are permanently ascending. The axillary buds are protected between the leaf and the axis. Their leaves also remain erect for a long time.

In *Trianthema* the opposite leaves of a pair are joined by a thin membrane.

Cypselea has membranous stipules.

In *Telephium Imperati*, Linn., the leaves are stipulate, alternate, oblong or subelliptic, entire, glabrous, glaucous, with a distinct midrib, but the other venation obscure, and narrowed to a very short petiole.

The stipules are ovate or roundly ovate, obtuse, scarious, nerveless, colourless, glabrous, intrapetiolar, adnate to the base of the short petiole, very broad and overlapping one another considerably on the contiguous sides, auricled at the base on the posterior side. The internodes being very short, the leaves are much crowded together on the young stems, so that the latter are completely enveloped by the adpressed stipules. The stems branch at the base, but little, if at all, upwards, so that the stipules have only the terminal buds of each shoot to protect. The outer leaves of the bud are about twice as long as their own stipules, lying in front of them, but a large number towards the centre only equal their stipules in length. The epidermal cells of the stipules are very wavy or curved, while those of the leaves themselves are shorter and polygonal. The stipules protect the tender young stems and their terminal buds.

ARALIACEÆ.

Stipules adnate to petiole, connate, persistent.

In *Aralia elegantissima*, Veitch, the persistent stipules are adnate to the base in the lower half, then becoming free, intrapetiolar, and forming a connate, emarginate piece fitting closely to the stem, to which their inner face conforms.

The terminal bud is protected by several pairs of overlapping stipules rolled round it. All the leaves so protected are younger than the stipules which surround them, no leaf deriving any protection from its own stipules.

Axillary buds are not developed into shoots upon young plants, but where they might occur they are protected by the stipules, which often persist after the leaves have fallen.

Stipules convolute ; base of petiole amplexicaul.

Mackinlaya macrosciadea, F. Muell.—The stipules are adnate to the dilated base of the petiole, but free for more than half their length, the upper portion being intrapetiolar and connate along the anterior, but free along the posterior edges. The margins only are membranous, the rest being fleshy, involute, overlapping by their free edges, curved inwards towards the axis, and persistent. They are about 2·8–3 cm. long, the free portion being 2·2 cm., and permanently rolled together, resembling a small horn.

The terminal buds are surrounded or enclosed by the dilated base of the petiole and by the convolute stipules of the uppermost or youngest expanded leaf.

PASSIFLOREÆ.

In *Tryphostemma trilobum*, Bolus, and two other species of the genus, besides the small subulate stipule at the base of the leaf-stalk, there are on the stem above the leaf and above the axillary flower-peduncle two sessile, more or less sagittate appendages, which resemble the true leaf in consistence, colour, and character of margin.

In Hooker's 'Icones,' t. 1838, these appendages are described as stipules ; but Harms, who supplies the account of Passifloreæ for Engler & Prantl's 'Pflanzenfamilien,' says :—" Whether these leaf-structures represent parts of the stipules or belong to the inflorescence is questionable." They are large enough to afford considerable protection to the bud, a function which the minute stipules could scarcely share. See also *T. apetalum*, Baker fil. in Trans. Linn. Soc. ser. 2, Bot. vol. iv. pl. 3.

CUCURBITACEÆ.

W. Burck, " Beiträge zur Kenntniss der myrmecophilen Pflanzen u. der Bedeutung der extranuptialen Nectarien," in Annal. Jard. Buitenzorg, x. p. 75, refers to stipular glands, and figures them in *Trichosanthes tricuspidata*, Lour., in his pl. 11.

CAPRIFOLIACEÆ.

Sambucus Ebulus, Linn.—Stipellæ ovate or suborbicular, small but foliaceous, and tipped with a gland. Stipules interpetiolar, foliaceous, in two very unequal-sized pairs. The lowest and contiguous pair occupying the central line of the axis, vary from linear to lanceolate or cuneate, shortly stalked and toothed above the middle. On the lower part of the young and growing shoot they are slightly separated from one another, but a little higher up they are closely contiguous. The larger *stipules* are ovate, acute, serrate, stalked, 3–5-nerved, resembling true leaflets, and inserted right and left contiguous to the small ones, but having longer stalks they rise above and partly overshadow the latter. Both pairs are involute in bud.

In the bud state the same relative sizes of the stipules are maintained; but the *smaller pair* are very minute in the earlier stages because they come opposite the midribs or the base of the short, very stout petioles of the next pair of leaves. They become larger and slightly convolute as the bud enlarges and the leaves grow. The *larger pair* have ample room for development in the hollow space between the petioles of the leaves to which they belong, as seen in *Viburnum Opulus*, Linn., but on a larger scale. They become convolute at a much earlier stage than the small ones.

The leaflets are involute in bud, and closely packed against one another. They enlarge, but do not begin to unroll till the leaf, as a whole, is 60 to 80 mm. or more in length. The terminal leaf is the first to unroll; and all do so from the apex downwards.

The markedly connate leaves of *Triosteum* and *Lonicera Caprifolium* render stipules unnecessary for bud-protection.

Dammer, in Oesterr. bot. Zeitsch. 1890, p. 261, and Fritsch, *ib.* 1889, p. 214, describe the occurrence and development of the stipules and nectaries in the species of *Sambucus.*

RUBIACEÆ.

For *Sarcocephalus*, see Potter, in Journ. Linn. Soc. 1891, p. 348.

Groom, Trans. Linn. Soc. (2) iii. p. 258, describes the stipules and their development with their investing colleters in species of *Cosmibuena*, *Coprosma*, *Hoffmannia*, *Gardenia* (*G. florida* and *laurifolia* (?)), *Pavetta*, and *Pæderia*.

K. Schumann (Engler & Prantl, Pflanzenfamilien, iii. Teil 4, Abth. p. 12) figures the bladders, inhabited by ants, at the base of the leaves of *Duroia saccifera*, Hook. f., and *Remijia physophora*, Benth. He does not, however, regard them as stipules, but as "sac-like outgrowths of the blade"; they lie at the base of the leaf near the middle nerve.

Cinchona officinalis, Linn.—The leaflets are slender, grooved above, slightly dilated at the very base, downy with adpressed hairs. The stipules are inserted upon the stem and are interpetiolar, but pass in front of the petioles, and touch by their free edges. They are erect, lanceolate, hairy, especially at the edges, and enclose the next younger pair of leaves. They become brown and are disarticulated from the axis, very soon after they cease to be useful.

The terminal bud is amply protected by the stipules of the youngest expanded pairs of leaves.

The axillary buds are at first very minute and densely covered with hairs, as is the stem around them. Some of those on the bud are much longer than the others.

Catesbæa spinosa, Linn.—The stipules are small, interpetiolar, connate, but very short in front of the petioles, very soon becoming dry and pale, but persisting for some considerable time.

The terminal bud is enclosed by the two pairs of connate stipules belonging to a pair of leaves forming the youngest unfolded pair. Each pair of leaves lies face to face and flat in bud, pushing from inside the stipules in that manner.

The axillary buds are of two kinds, in the axil of each leaf. The first to develop is a sharp spine without any leaves. The other is very small in the resting stage, and lies between the spine and the petiole of the leaf. It is also covered and protected at this stage by the stipules, and is probably a lateral bud from the spine.

Carissa spinarum, Linn., is very similar in habit and form, but has smaller leaves. It also bears a pair of spines in the axil of *one* leaf of every *alternate* pair.

In *Gardenia jasminoides*, Ellis, the stipules are connate into a sheath closely investing the stem, rounded at the apex, and obliquely cut down one side for nearly half its length. This sheath consists of the four or six potential stipules completely united into one piece having many longitudinal nerves. They are therefore inter- and intra-petiolar, and do not at any time protect the leaves to which they belong.

The terminal bud in the resting condition or in a small state is completely invested by the sheathing stipules of the last or uppermost fully-developed pair of leaves.

The axillary buds are protected inside the sheath in their early stages, ultimately pushing their way out. Sometimes the axis of the axillary shoot remains adnate to the primary one, and gets carried up with it, clear out of the sheathing stipules.

In *Coffea bengalensis*, Roxb., the stipules are inter- and intrapetiolar, each pair being connate between the petioles and drawn out into a long, slender point; they are also connate for a short way at the base, in front of the petioles, thus forming a short cup round the bud or the axis according to the stage.

The terminal bud is covered by the stipules, which are longer than the leaves to which they belong. The stipules belonging to two pairs of leaves completely cover the bud; but the inner set of stipules have only their midribs or little more exposed. The leaves are folded over the bud in vernation, so that one pair with their stipules cover the whole bud.

The axillary buds are protected by the petioles and the stipules belonging to them. Their first leaf or pair of leaves appears to remain small, and falls early. The stipules often persist for some time after their leaves have dropped.

Stipules leaf-like.

In *Rubia tinctorum*, Linn., the leaves are lanceolate (on the lower part of the stem at least), acuminate, one-nerved, sessile, stipulate, opposite, although often termed verticillate. Their true character may be seen by an examination of the underground portions of the annual flowering-stems, which are obtusely tetragonal.

The subterranean leaves are opposite, or frequently three in a whorl, decussate, broadly triangular, obtuse, connate sometimes for two-thirds of their length, sheathing the stem, round which they form a cup, exstipulate.

The aerial leaves, which become green and perfectly developed, are also connate at the very base, forming a shallow cup. The first pair have one stipule in the space between each leaf, and the two leaves and two stipules occupy the four angles of the stem. The second pair have two stipules between each leaf, lying right and left of the angle of the stem, showing that they have arisen by the fission of one or by the stipule from each leaf being perfectly developed.

The stipules of the aerial leaves are somewhat smaller.

COMPOSITÆ.

In *Achillea Millefolium*, Linn., and the other species examined, the petioles are dilated at the base. In *Chrysanthemum* also the buds are protected by the dilated bases of the petioles, which have sometimes a more or less developed membranous margin, and in some species of the genus small free auricles. In *C. parthenifolium*, Pers., the leaves are also frequently furnished with a small foliaceous segment on each margin near the base, and resembling stipules. Occasionally other small scattered segments intervene between the basal ones and the lamina proper. They may therefore be regarded as segments of an originally sessile leaf. In *C. sinense*, Sabine, also the petioles are auricled in a manner much resembling stipules.

Barnadesia rosea, Lindl., has two thorns at the base of the leaf-stalk. Stipule-like auricles occur in *Senecio*, *Trixis*, *Jungia*, and other genera.

DIAPENSIACEÆ.

Diapensia lapponica, Linn.—The terminal bud is deeply sunk in the centre of the small rosette of leaves. The sheathing, imbricate bases of the leaves form a cylinder round it. When the young leaves commence to develop, they do so alternately, and two of them cover over the top of the younger members. There are no scale-leaves, as the terminal bud is continuous, but becomes arrested during the winter season.

The axillary buds are well protected in their early stages by the sheathing portion of the leaf, which is one-third to one-half as long as the lamina.

This type is similar to what occurs amongst many of the species of *Saxifraga* of dwarf and densely tufted habit.

In *Shortia galacifolia*, Torr. & Gray, the petioles are dilated at the base. The terminal bud in the resting stage is covered with numerous concave, glabrous, red scales, surrounded by a few very much reduced leaves of the previous season. The scales evidently represent the dilated base of the petiole.

Schizocodon soldanelloides, Sieb. & Zucc., has much shorter petioles; but otherwise the arrangement is similar.

PLUMBAGINEÆ.

Statice Limonium, Linn.—The winter-bud is covered and protected by arrested leaves, which are complete but simply reduced in size, particularly the lamina. The base is greatly dilated and triangular, so that few leaves are required to completely enclose the bud.

The perfect leaves have the lamina decurrent upon a deeply channelled petiole, with narrow membranous margins; the base is greatly dilated and clasping, like the leaves of the winter-bud. The base long remains erect and, with the deeply channelled petiole, affords protection to the young leaves till they attain considerable size. There are no stipules, although the upper end of the sheath is occasionaly slightly (perhaps accidentally) free. One edge of the leaf is convolute in bud and the other is rolled over it, so that the midrib is exposed.

In *Armeria maritima*, Willd., the leaves are linear, channelled, carinate, pubescent, gradually and considerably dilated to the base, membranous there at the edges, and persistent.

Those of the winter and summer buds are very similar. They are crowded together and protect one another, three of them completely surrounding all the younger ones, while two of them accomplish this at the base, where they even overlap one another. They also remain erect for about half their length, and the withered ones of the previous summer also remain in position. Add to this the fact that the plant is densely cæspitose, and it will be seen that the young leaves are abundantly protected, more so than in the case of the species of *Statice*.

In *Ægialitis* the leaves are crowded at the end of the branches, roundish and fleshy, with a winged leaf-stalk.

MYRSINEÆ.

The Myrsineæ are exstipulate.

In *Clavija undulata*, D. Don, the petioles are thickened towards the base. The terminal bud is conical, covered with numerous very much reduced and scale-like deciduous leaves. The lower ones are very narrow, hardened and spiny, consisting of the midrib and a very narrow margin. Those which follow somewhat larger and broader, but never develop into perfect leaves. The perfect and persistent leaves are crowded together around the apex of each season's growth, so that the stems and branches are merely furnished with a terminal tuft of leaves.

The axillary buds are slightly extra-axillary, very small, covered with small scales and rust-coloured scurf. They consist mostly of flower-buds, and leafy buds seldom develop.

SALVADORACEÆ.

Azima tetracantha, Lam.—Leaves opposite, decussate, lanceolate, acuminate, entire, petiolate, stipulate, glabrous, persistent; petiole very short, channelled above but not dilated at the base. Stipules minute, about 0·25–0·30 mm. long, subulate, pale, but soon becoming light brown, and gradually breaking away from the top downwards, but persisting for some time. They appear to be of little protective value.

The terminal bud consists of a pair of leaves closely applied face to face, attaining some size before they expand, and protecting the younger members between them.

The axillary buds are rather remarkable. What appear to be two spines situated in the axil of the leaf, are really the first pair of leaves of the axillary shoot. In their early stages they are erect, closely applied and very short, but when fully developed they become hard, spiny, and diverging. Their foliar nature is further indicated by the fact that a slender groove runs along the opposing faces from apex to base, where there is a deeper cavity as if a sheath were attempted. They are also articulated with the stem. The second and third pairs of leaves on the axillary shoot (when the latter develops) are reduced to scales which decussate with the spines. True leaves follow the scales. The spines protect the plant generally, and are developed before the axillary shoot elongates; they also, together with the two pairs of scales, constitute a further protection to the axillary buds.

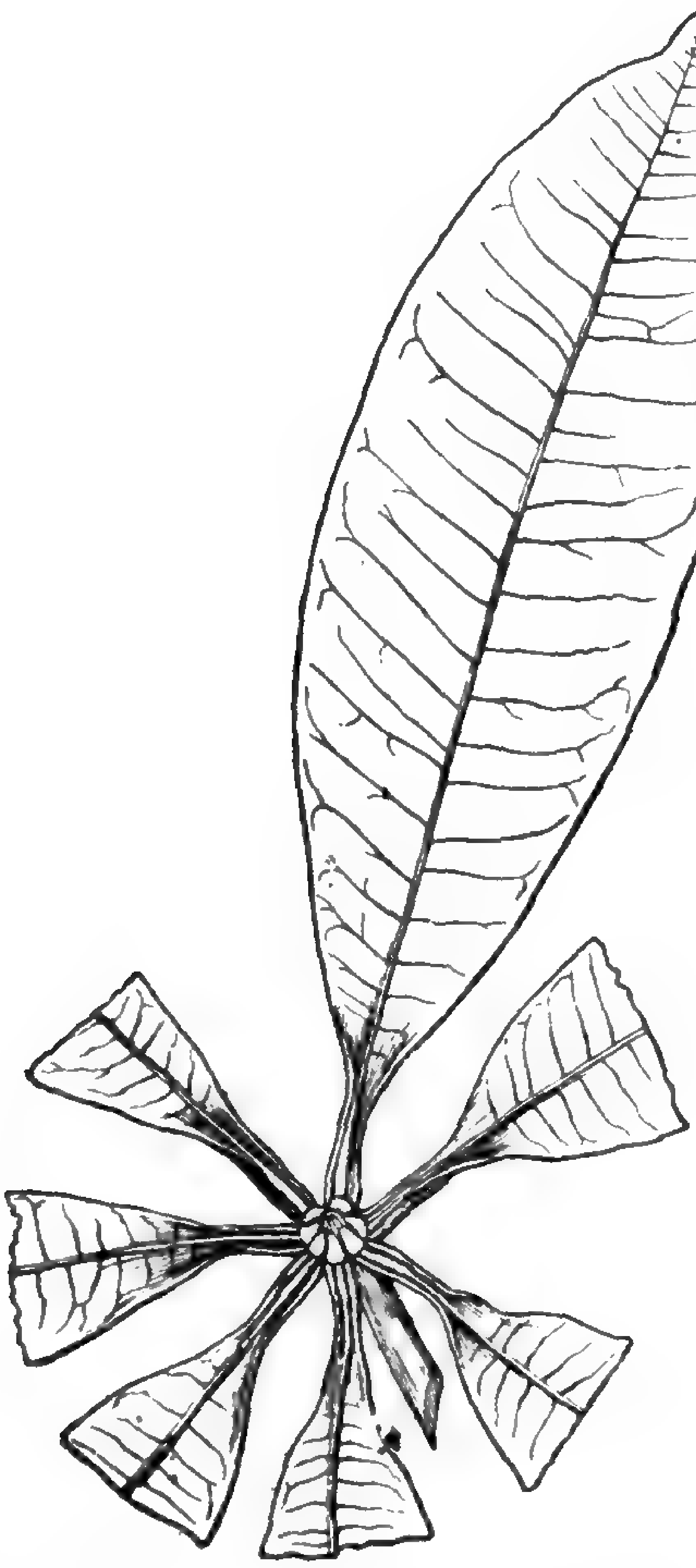
In some respects therefore *Azima tetracantha* offers an interesting analogy with *Catesbæa spinosa*, Linn. (Rubiaceæ), and *Carissa spinarum*, Linn.

APOCYNACEÆ.

In *Alstonia scholaris*, R. Br. (fig. 5), the leaves are whorled at the apex of each growth, in groups of 6 to 9, narrowly oblong-elliptic, narrowed to both ends, but obtusely pointed, closely but somewhat irregularly feather-nerved, with the nerves nearly at right angles to the midrib and uniting in a slender vein traversing the whole lamina immediately within the margin; entire, glabrous, persistent, deep green above and whitish beneath, shortly petiolate.

The petioles are semiterete, flattened above, and furnished with a ligula or outgrowth from the base of the upper face, protecting the bud. This ligula is triangular, obtuse, pale green, 1·5–2 mm. long; collectively they form a whorl, covering all but the extreme apex of the bud (fig. 5).

Fig. 5.



Alstonia scholaris.—Terminal whorl of leaves to show ligules covering the bud. (Reduced about ½.)

Groom (Trans. Linn. Soc. ser. 2, Bot. iii.) compares the ligule with the ledge-like stipular process of *Tabernæmontana*, and describes the manner of bud-protection in *T. dichotoma* (p. 261).

In *Apocynum androsæmifolium*, Linn., the petioles are grooved or concave. The terminal buds are protected by a pair of leaves which are opposite or nearly so. The stipules are subulate, glandular, and occupy the spaces between the narrowed bases of the leaves. The winter-buds are subterranean, generally numerous, and protected by leaves reduced to the condition of small ovate bracts, adpressed to the stem till the buds in their axils push them away.

In *Beaumontia* the bud is protected by the older leaves in succession. They are sessile while in bud. The base of the petioles is connected by a rim across the stem, and there is also a ring of subulate glandular processes surrounding the axis, which, however, can hardly be regarded as stipules. The axillary buds are protected by the broad and thickened bases of the petioles.

ASCLEPIADEÆ.

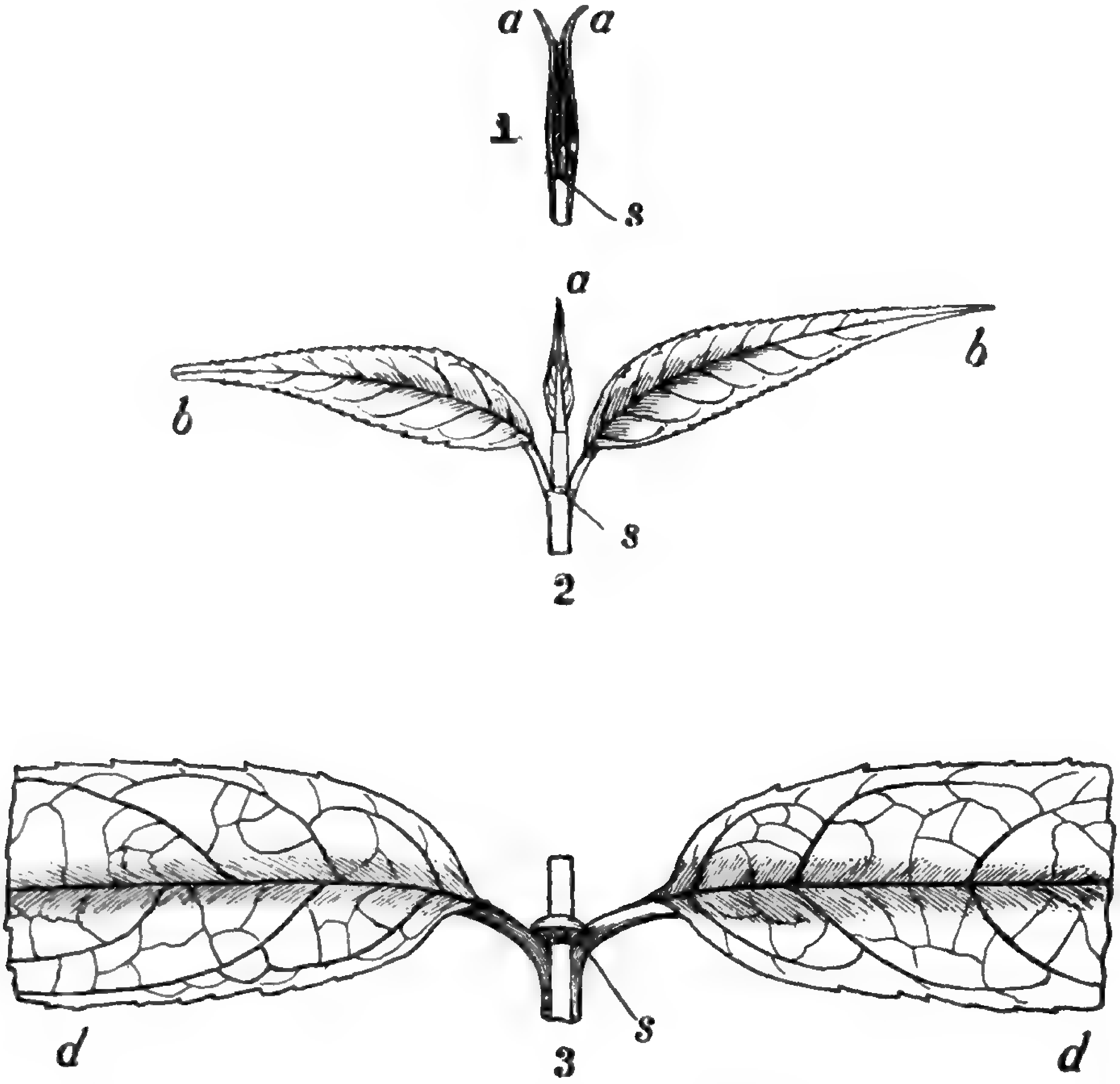
In the bud each leaf has its edges opposed to, and in contact with, those of its fellow, so as to cover the bud completely. The apex spreads out first, the rest remaining erect or nearly so for some time, thus helping to protect the terminal bud. *Vincetoxicum officinale*, Moench, has the petiole deeply channelled above, slightly dilated at the base, and inserted on a pedestal, which is broader and with its fellow nearly encircles the stem. The base of the lamina is furnished with glands, which fall away as the leaf develops.

LOGANIACEÆ.

The leaves of *Buddleia* are opposite and connected at the base by a transverse line upon the stem, rarely by herbaceous stipules as in the case of *B. auriculata*, Benth. (fig. 6). In this species the stipules are interpetiolar, connate into one suborbicular piece, and strongly revolute at the edges, making them convex above and deeply concave beneath, almost like the cap of the calyx of *Scutellaria*, 3·5 mm. wide, projecting about 2 mm. from the stem, and of the same colour and texture as the leaves, pubescent above, and hoary with a fine adpressed tomentum beneath, but similarly hoary all over when quite young like the expanding leaves.

The petioles are deeply channelled above and dilated at the base, so that they protect the axillary buds in their earlier stages. When the leaves are just expanding, the petioles are merely connected at the base by a slightly elevated rim, or, in other words, they are slightly connate. The stipular outgrowth develops as the leaves gradually attain their full size, so that it is functionally of no importance either in protecting the terminal or the axillary buds. This is done by the leaves themselves. The latter are flat in bud and closely applied face to face, protecting the terminal bud, and as they are decussate, the edges of the next younger pair of leaves are accommodated in the channel along the midrib of the next older pair, so that all fit very closely in bud.

Fig. 6.



Buddleia auriculata.—1. *a*, *a*, two of the oldest unexpanded leaves of a bud, × 2; *s*, stipule. 2. *a*, unexpanded leaf, underside; *b*, *b*, first expanded pair of leaves, × 2; *s*, stipule. 3. *d*, *d*, third older pair of expanded leaves, × 2; *s*, stipule.

In ***Buddleia Colvilei***, Hook. f., the leaves are opposite, decussate, petiolate, but sessile in bud, tomentose on both surfaces with hairs of a pale rusty colour, especially in the early stages; petioles concave above, dilated at the base, where they are slightly connate or connected by a rim across the stem.

The terminal bud is protected by each successive pair of leaves, which are flat, adpressed face to face in bud, and the outer pair attain considerable size before expansion. The edges of the next younger pair of leaves are exposed before the expansion of the older ones, but are protected by tomentum.

The axillary buds are protected by the dilated bases of the petioles, which retain an erect or ascending direction for some time.

The rim connecting the bases of the petioles sometimes develops a foliaceous auricle like that of *B. auriculata*, and frequently a lanceolate foliaceous process is developed on one side of the stem, instead of the auricle, and on different sides of the stem at different nodes. Neither of these processes is much developed in bud, and they do not appear to form any effective protection.

In *Buddleia globosa*, Hope, the leaves are opposite, decussate, lanceolate, acuminate, densely felted beneath with a fine silvery tomentum. They are all but sessile and the base is slightly dilated, semiamplexicaul, and connected by a rounded transverse ridge. There is no interpetiolar and stipular outgrowth as in *B. auriculata* and *B. Colvilei*.

The terminal bud is tetraquetrous and greatly elongated before the leaves expand. Two of them completely cover it, and their edges lie flat upon one another, but the centre of each leaf is deeply channelled so as to accommodate the younger members.

Axillary buds are frequently present, and they are sheltered in their earlier stages by the erect base of the leaves before they become fully expanded, and also by their own tomentum.

In *Fagræa zeylanica*, Thunb., the leaves are opposite, decussate, very unequal, petiolate, exstipulate, obovate, gradually narrowed into the petiole, glabrous, entire, softly leathery or semi-fleshy. The petioles are short, very stout, compressed laterally, furrowed at the base only on the upper side, considerably dilated at the base and auricled; the auricles are erect and clasp the stem in front of the petiole; they are not connate.

The terminal bud in the resting stage is included between and beneath the auricles. When it commences to grow, the very unequal pair of leaves are closely adpressed face to face and emerge thus more easily from the encasement formed by the dilated and auricled petioles.

The axillary buds are completely covered or enclosed in the same way. Except for the slit sheath or case, this agrees with *Clusia* and also entirely with the species of *Anthocleista*. Conf. also *Citharexylum*.

The stipules in *Fagræa* spp. are well shown in Blume, 'Rumphia,' ii. plates 72–81; they are largest in *F. auriculata*, Jack, and described on p. 26 as follows :—" The extreme base of the petiole is enlarged like a short ligule, triangular in shape, obtuse or retuse, connate round the stem, with two lateral, reflexed, semilunar, thick foliaceous auricles convex above and concave beneath." They would afford a very complete protection to the axillary bud. See also W. Burck, "Beiträge z. Kenntniss der myrmecophilen Pflanzen," in Annal. Jard. Buitenzorg, x. p. 75, where the pouch-like auricles in *Fagræa imperialis*, Miq., are described as the homes and nests of ants.

GENTIANEÆ.

The Gentianeæ have no true stipules. In the true Gentians the older leaves are connate at the base, forming sheaths which protect the younger ones.

In *Menyanthes trifoliata*, Linn., the petiole is described as sheathing. This sheath attains a length of 8 cm. or more, completely investing the bud and sheathing the stout fleshy stem. The broad margins are thin and membranous, gradually narrowing upwards and adnate to the petiole except at the top, where there are two short, unequal, free auricles. Just beneath these auricles the membranous margins approach one another and unite in front of the petiole, forming a small hood.

The sheath of the oldest unfolded leaf protects all the younger members of the bud, but not its own petiole or lamina.

BORAGINEÆ.

In *Cordia Myxa*, Linn., the leaves have a petiole which is dilated at the base, protecting the small axillary buds.

See Mez, in Engl. Bot. Jahrb. xii. p. 526, "Morphologische u. anatomische Studien über die Gruppe der Cordieæ."

BIGNONIACEÆ.

The Bignoniaceæ are, as a rule, exstipulate.

In *Bignonia Fraseri*, Hort., the leaves are opposite, decussate, compound, petiolate, exstipulate, glabrous, persistent, with one pair of cordate, acuminate, dentate, stalked leaflets and a terminal trifurcate tendril; the petiole is wiry, terete, dilated at the very base, with a slight depression on the upper side.

The terminal bud is made up of numerous decussate leaves, the two largest of which cover all the younger members. At this stage they are shortly petiolate or sessile; the leaflets are as long, or slightly longer than, the terminal tendril and conduplicate, so that the edges touch those of the opposite leaf, and little except the midribs and tendrils of the outer ones are exposed.

The axillary buds are covered and protected by a pair of ovate, concave, acuminate leaves reduced to the condition of scales. Their succeeding leaves are perfect and arranged like those of the terminal bud.

ILLECEBRACEÆ.

In *Paronychia serpyllifolia*, DC., the leaves are small, oblong-lanceolate or often subelliptic, tapering into a short petiole, ciliate at the edges, and showing a midrib on the under surface with two faint lateral nerves, evergreen, opposite, stipulate. The stems being prostrate, all the leaves are turned to the upper side. The stipules are large, lanceolate, acuminate, scarious, shining, interpetiolar, overlapping one another considerably at the base, and consisting of greatly elongated slender cells, lying parallel with one another longitudinally. The stipules of one pair of leaves protect the next younger pair, and those of the uppermost fully expanded pair equal the next younger pair (forming the winter-bud) in length. The second younger pair of the bud-leaves are very much shorter than the stipules of the first or outer pair. The stipules always attain their full length before the leaves to which they belong. The stipules therefore obviously serve for the protection of the young leaves. They protect not only those of the terminal buds but also the axillary buds, which are very numerous—the prostrate or creeping stems being very much branched.

Corrigiola littoralis, Linn., has the leaves alternate or the first pair opposite, linear-lanceolate, narrowed to the very base. The stipules are subulate or half-sagittate, with a small auricle at the base on the posterior side, thin, colourless, membranous, and erect. The internodes of the young shoots are very little elongated, so that the leaves are crowded together as well as the stipules, which at this stage assist in protecting the terminal bud. Axillary buds are freely produced, and in their earlier stages are protected by the erect stipules.

In *Scleranthus annuus*, Linn., the subulate, acute, somewhat pungent leaves are opposite, but not strictly decussate, as each pair is inserted a little farther round the stem than the second pair below, not vertically above it. The alternate pairs therefore assume a spiral arrangement, just as in the Screw Pine

Pandanus). This allows a more equal distribution with regard to light, and would appear to be desirable owing to the undeveloped state of the internodes and the consequent crowded condition of the leaves in dense rosettes. The leaves are exstipulate, but connate at the base, forming a cup of some depth around the axis and the numerous young leaves surmounting and protecting it; the edges of the free portions are ciliate-serrate for some distance above the union. In the earlier stages of the development of the leaves the ciliæ interlock more or less with one another, thus serving to keep the young leaves compact over the crown of younger ones as well as the growing point of the axis.

Scleranthus thus holds the same relation to *Paronychia* amongst the Illecebraceæ, as *Dianthus* and *Sagina* do to *Spergula* and *Spergularia* amongst the Caryophylleæ. In both orders where stipules are wanting the leaves are connate at the base.

POLYGONACEÆ.

In *Atraphaxis lanceolata*, Bunge, the leaves are oblanceolate, alternate, shortly petiolate or subsessile, and articulated with a persistent pedestal; revolute in bud. The stipules are ocreate, adnate to the pedestal throughout its length, then connate both anteriorly and posteriorly into a cylindrical sheath fitting closely to the axis above its leaf, and terminating abruptly except for two lateral prolongations forming subulate points as long as the cylindrical portion.

The free portions of the stipules are of service in protecting the terminal bud, where the leaves are rather crowded and the free points of several ocreæ together form a small conical mass covering the young leaves. They also lend additional protection to the axillary buds by being erect and closely applied to them. The first leaf of axillary buds is reduced to its sheathing stipules, so that altogether the axillary buds are well protected.

In *Atraphaxis spinosa*, Linn., where the stipules are as in *A. lanceolata*, the terminal buds are protected by the ocreæ and the apex by the subulate prolongations. In the autumn these harden and die, becoming spiny. Axillary buds are also protected by ocreæ. The portion of the latter that is adnate to the pedestal is persistent after the fall of the leaf, while the thinner portion extending round the axis falls away. The long fringe-like points are also persistent. A number (apparently three) of the primary leaves of the axillary buds are reduced to their stipules, which are membranous, closed at the top, and longer than the buds, thus forming so many caps over them and answering the purpose of scales as seen in deciduous trees, but without the apical prolongations. Succeeding leaves are perfect, with the lamina protected as in the growing bud. Growth is resumed by these axillary buds only.

The prolongations of the ocreæ in the bud stage are represented by two short teeth, which elongate on the resumption of growth.

In *Polygonum equisetiforme*, Sibth. & Sm., the leaves are alternate, sessile or subsessile, small, linear, strongly and permanently revolute at the margin.

The ocreate stipules are adnate to the petiole or leaf for half their length, and connate into a cylindrical sheath 2–4 mm. long, closely fitting the stem, and terminating in numerous subulate, membranous teeth or fringes $\frac{1}{3}$ to $\frac{1}{2}$ as long as the sheathing portion. The latter is green and striated exactly like the stem, and is persistent; the terminal fringe soon becomes brown, though pale and scarious at first, and gets variously torn and broken away. The stipules may be described as slightly intrapetiolar, seeing that they are connate for a very short distance in front of and above the insertion of the leaf upon the sheathing portion.

The leaf is not protected by its own stipules, but by those of the next older leaf or leaves. The terminal bud forms a small cone covered by the stipules of several leaves, and the scarious portion lies over the top. From this cone the leaves emerge in succession, but never expand or alter their form.

The axillary buds are protected by the sheathing portion of the ocreæ till they attain some size, and likewise by numerous stipules belonging to their own axis.

In *Muehlenbeckia platyclada*, Meissn., the leaves are alternate, distichous, shortly petiolate, stipulate, oblong and entire or hastate, and are inserted on the edges of the stem, and deciduous or even caducous; the petioles are short, tapering to the base, and slightly winged or sometimes very little developed. In many cases the lamina and petiole are wanting.

The ocreæ or stipules are adnate to the petiole at the base only, and then becoming free, intrapetiolar, closely investing the stem and connate; they are very thin, membranous, hyaline, and often difficult to distinguish from the stem, although on the younger portions of the same they measure 1–1·25 mm. long. As they get old, they usually crumble away, leaving only the thicker portion close to the petiole, and connected by a mere rim round the stem.

The stems are very much flattened, thin, leaf-like, deep green, and more or less constricted at the nodes.

The terminal bud is covered by numerous ocreæ whether there are leaves present or not. Where leaves do occur they are revolute at the edges, very narrow, applied to the edges of the stem, and more or less curved over the apex of the bluntly tapering bud. Lateral buds arise in the axils of the ocreæ, which the buds cover till growth pushes aside or ruptures them. The lateral buds often become more or less fascicled, apparently by the development of secondary buds from the base of the primary ones, after the latter lengthen into shoots. The primary or lowermost internodes of these shoots are undeveloped.

According to the 'Genera Plantarum' (iii. p. 101), *Muehlenbeckia platyclada* is remarkable from having its branches entirely leafless and the ocreæ reduced to a transverse line. This description has probably been drawn up from dried specimens.

In *M. varians*, Meissn., the stems are long, slender, more or less prostrate, terete. The leaves alternate on the $\frac{2}{5}$ plan, are deltoid, entire or trilobate or hastate. The stipules are adnate to the base of the petiole, then intrapetiolar, connate into a cylinder closely investing the stem, membranous and gradually crumbling away.

Terminal and axillary buds are protected much in the same way as in *M. platyclada.*

ARISTOLOCHIACEÆ.

The Aristolochiaceæ are exstipulate.

In *Asarum europæum*, Linn., the winter bud is aerial and protected by two or three amplexicaul downy or tomentose leaves reduced to scales. These enlarge upon the resumption of growth in spring, and become somewhat hooded. They are arranged on the $\frac{1}{2}$-plan.

The axis becomes elongated for about 2–2·5 cm., and terminates in a pair of cordate or reniform, long-stalked, opposite leaves. The base of the petiole is concave, surrounding and protecting a terminal bud, which repeats the annual increment of growth the following year. On strong shoots a single flower arises in the axil of one of these leaves. Thus the young and tender growth is amply protected.

Aristolochia elegans, Mast., while really exstipulate, has a small, cordate, membranous, subsessile leaf in the axil, which resembles a single intrapetiolar stipule or even a pair. Close examination shows that this stipule-like process is really the first leaf of an axillary axis or bud. It clasps the main axis with its auricles, and has two buds in different stages of advancement lying between it and the petiole of the leaf in whose axil it occurs. The small leaf belongs to the larger and more advanced bud.

On examination of the terminal bud of the main axis, the axillary buds, especially one of them, are seen to be already in an advanced state. The stipule-like leaf is conduplicate over the larger bud, but being much wider than the latter even when folded, its margins become involute, so that the bud is subulate in outline. The stipule-like process has therefore been developed for the protection of the larger and most advanced axillary bud, which it completely covers.

The terminal bud, consisting as it does of numerous leaves in an advanced state, is protected by its own leaves, the older protecting the younger. All the leaves on the main axis are conduplicate, folding one inside the other successively, with the two halves and their edges perfectly flat, not involute, as in the case of the stipule-like leaf when in bud.

PIPERACEÆ.

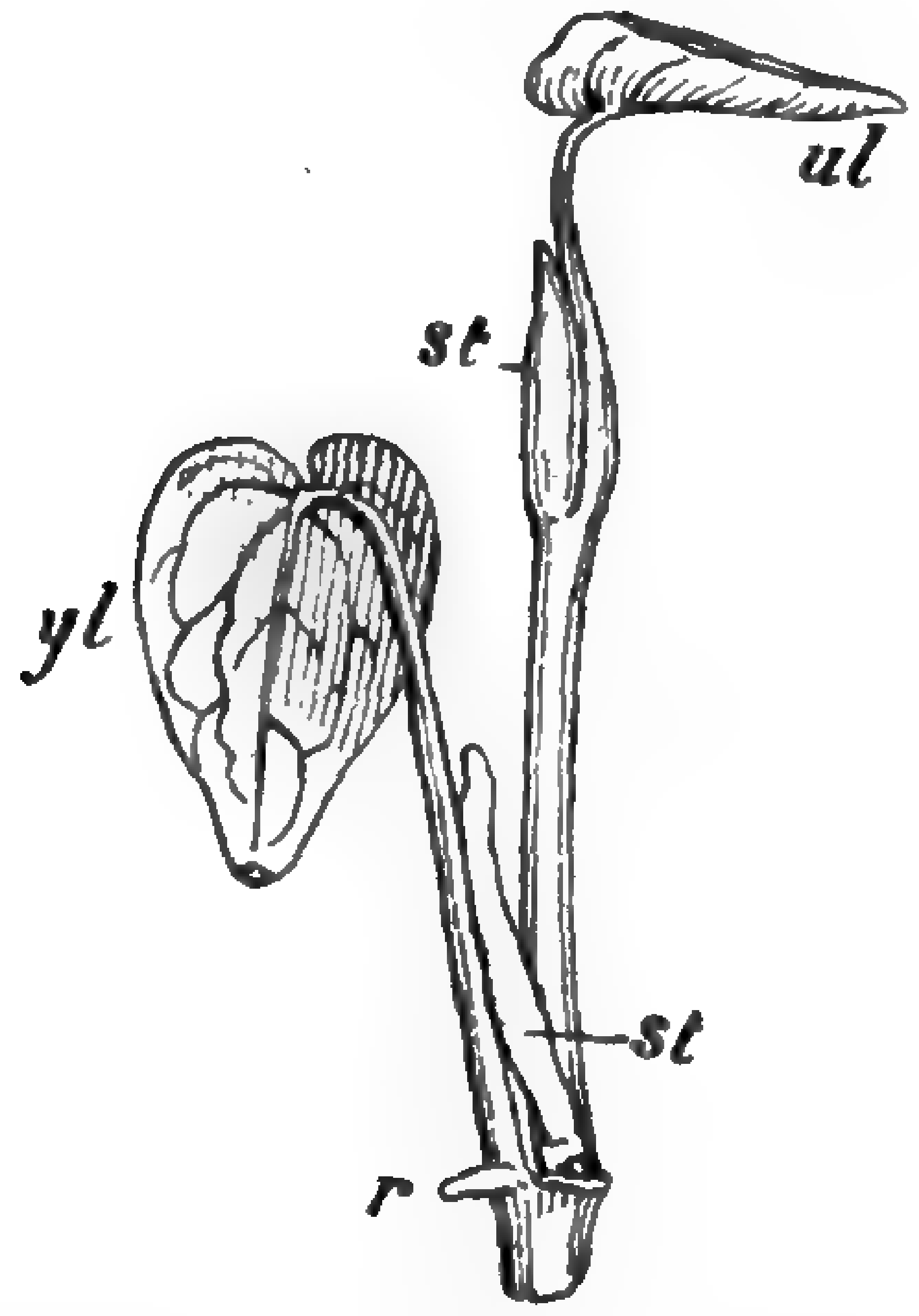
In *Piper longum*, Linn, var. *sarmentosum*, the leaves are alternate, petiolate, stipulate, rotund, cordate, acuminate, or rather cuspidate, 5–7-nerved with incurved nerves, and persistent, involute from the edges to the midrib in bud, forming a cylindrical mass; the petiole is semiterete, grooved above, but more deeply so inside the stipules.

The stipules are 9–15 mm. long, adnate to the lower half of the petiole, converging towards the apex and free at the tips, strongly overlapping by their free edges, adnate by their base all round the axis, becoming brown and disarticulate from the petiole after the leaf is fully developed. In all these respects they closely resemble those of *Magnolia*, except that their posterior edges are free and much imbricated, but not connate.

The terminal bud is protected by the stipules of the youngest unfolded leaf. The petiole of the latter is erect at this stage, and appears continuous with the axis.

Axillary buds are protected by the sharply ascending, deeply grooved petioles of fully developed leaves. The first leaf of these buds is reduced to its stipules, which form a sheath.

Fig. 7.



Piper longum, var. *sarmentosum*, ad nat.—*r*, rootlet from node; *st*, stipule becoming disarticulated from the petiole; *st*, stipule enclosing the apical bud; *yl*, young expanded but not full-grown leaf; *ul*, unopened leaf in process of expansion.

In *P. dioscoreæfolium*, the leaves are narrowly cordate, acuminate, shortly petiolate, 5-nerved, thin, membranous, and persistent; petioles semiterete, deeply concave at the very base only. Stipules about 4 mm. long, otherwise like those of the last species. Those of the resting-buds are smaller, narrower, and wholly adnate to the petiole.

Terminal buds are of two kinds, namely the growing and resting. As the leaves are evergreen, all buds are protected to some extent by them. The growing ones are protected by the more typical stipules with free points, which are deciduous. The resting-bud protrudes through an oval slit with membranous margins representing the stipules at the concave base of the last developed leaf. This bud is further protected by a leaf reduced to its stipules, with the petiole or arrested lamina represented by an excurrent tooth at the back of the stipules.

Axillary buds are frequent and may arise in the axil of the leaf or on the opposite side of the axis, and apparently from the axil of a leaf reduced to its stipules. Axillary buds as well as the resting terminal ones seem always to have their first leaf reduced to the stipules, which would correspond to the scales of winter buds in many other natural orders.

In *Piper ornatum*, N. E. Br., the stipules resemble those of *P. longum*, but are free from the petiole for the upper half of their length.

In *Zippelia* the leaves are cordate, with amplexicaul stipules.

In *Peperomia* the leaves are exstipulate; sometimes opposite or whorled.

CHLORANTHACEÆ.

In *Chloranthus inconspicuus*, Sw., the stipules are subulate, almost colourless, and inserted on the sheath between the petioles. Each young growth commences with two pairs of leaves reduced to a well-developed sheath and a short ovate tooth representing the lamina; they are exstipulate.

MYRISTICEÆ.

The Myristiceæ are exstipulate.

Myristica moschata, Thunb., has the leaves alternate, distichous, petiolate, exstipulate, oblong, entire, glabrous, coriaceous, involute in bud, persistent; the petiole short, nearly terete, shallowly grooved on the upper face, slightly twisted, not dilated at the base, or sheathing.

The terminal bud in the growing state consists of leaves strongly involute at the margins, slightly scurfy, and grasping the bud by their base in such a way that the midrib only of the next younger leaf is exposed. The leaves attain some length before unrolling, but continue to develop in size after they have become flat.

The axillary buds are very small, and in many cases appear as scaly, scarcely elevated protuberances. Towards the apex of the shoots they are slightly more elevated, scaly and scurfy.

MONIMIACEÆ.

This order is also exstipulate.

In *Peumus Boldus*, Molina, the leaves are opposite, decussate, petiolate, exstipulate, oblong-ovate, entire, downy when young, but scabrous on both surfaces when mature, very coriaceous, persistent; the petioles very short, slightly grooved above and slightly narrowed to the base.

The terminal bud is protected by each pair of leaves in succession. At this stage the leaves are sessile or subsessile, boat-shaped, sub-fleshy, cohering rather firmly by their edges, and enclosing all the younger members.

Axillary buds are already developing in the axils of the oldest, but still unfolded pair of leaves, and are thus amply protected in their earlier stages. After the leaves expand the erect petioles offer further protection. The first pair of leaves on the axillary shoot are reduced to small subulate scales, bearing a remarkable resemblance to stipules. By closing the space between the petiole and axis they perform the protective function of stipules covering the younger leaves except at the tip. The succeeding leaves are arranged like those of the terminal bud.

LORANTHACEÆ.

In *Viscum album*, Linn, the leaves are opposite, spathulate, entire, coriaceous, and narrowed to the base. The annual branches are all axillary and arise in the axils of the only pair of true leaves developed on each shoot. The base of the leaf is narrowed, and the cortical tissue of the upper surface develops into an elevated hood covering one half of the axillary bud.

Above the pair of true leaves are two decussating scales adnate to, or decurrent upon, the axis. All the four scales have thickened, triangular, free tips, articulated with the adnate portion. The latter may really be a thickening of the cortical tissue of the axis. At all events, this adnate portion at the line corresponding to the union of the two is developed into a hood protecting the other half of the leafy bud. The bracts all behave in the same way, so that the two lateral flower-buds are protected in the same way as the leafy buds below them. The terminal flower-bud is protected solely by the upper pair of bracts. The tips or the whole of the perianth of the flower-buds for next year are exposed at midwinter, and sometimes the ovary of the terminal bud as well, or partly so. A similar case occurs in *Clusia*.

The leaves appear to be pushed off annually upon the resumption of growth, for the thickened base of the shoots occupies the position of the leaves or the greater portion of it, leaving only a narrow scar.

EUPHORBIACEÆ.

The species of this family differ greatly as regards the stipules. In *Euphorbia palustris*, Linn., *E. lucida*, Waldst. & Kit., &c., there are no stipules. The bud is amply protected by the crowded leaves, the outer ones enclosing the winter-bud being reduced to scales. In *Pachysandra* (*P. procumbens*, Michx.) the arrangement is very similar.

In the Box also (*Buxus sempervirens*, Linn.) the winter-bud is covered by about five pairs of leaves reduced to scales. The lower or outer are spathulate and evergreen, like miniature leaves; the middle ones are triangular and brown; while one or two of the uppermost pairs elongate in spring, becoming linear and membranous. They persist for a year or more in a withered condition.

The perfect leaves are opposite, convolute in bud, with one edge out and the other inside, and the older protect the younger. A large number are crowded together, and the outer pairs protect all the younger members in the bud.

On the other hand, in *Acalypha* (*A. obovata*, Benth.) the stipules are linear-subulate, attenuate, inserted upon the stem at the extreme base of the petiole. They appear to be of little use in protecting axillary buds, but would serve to guard the terminal ones. Where the young leaves are crowded together, the stioules lie all round the bud and project beyond the leaves to which they belong.

In many species of *Jatropha* they form dissected hair-like structures standing in the axil of the leaf.

In *Pedilanthus* (*P. tithymaloides*, Poit.) the stipules, if such they may be called, are minute and apparently glandular. They fall early. The terminal bud is small and nestles at the base of the leaves. The axillary buds are minute, scaly, and covered with short hairs, forming minute grey tufts or nodules, sunk in a slight cavity in the stem, as in some of the Cacteæ.

In *Croton* (*C. lucidus*, Linn.) the stipules are small, palmately lobed with finger-like segments, glandular, inserted on the stem close to the base of the petiole, and generally or often persisting after the fall of the leaf, more or less hairy at the edges.

The terminal bud consists of a conical mass of sessile leaves, involute at their edges and densely stellately tomentose. The stipules assist in protecting the base of the buds, but even at this stage they are much shorter than the leaves.

Axillary buds in their early stages are protected by the petiole, stipules, and tomentum, except in those cases where they arise at nodes after the fall of the leaf. The stipules and a small elevation at the scar of the petiole then protect them slightly.

In *Mercurialis perennis*, Linn., the leaves are opposite, decussate, ovate or lanceolate-elliptic, petiolate, stipulate, crenate-serrate, pubescent, with ascending and slightly incurved nerves.

The variation in and evolution of the leaves may best be studied by an examination of the subterranean resting-buds and of the development of the stems with their leaves in spring.

Three pairs of leaves are reduced to the condition of scales without stipules, and there are two other pairs that more properly belong to the rootstock or rhizome. The first pair of the flowering stem are broadly triangular and slightly connate at the base, forming an efficient protection to the bud before growth commences. By the elongation of the internodes the second and third pairs become aerial. Each scar-like leaf is triangular, stem-clasping, and separated from its companion by an appreciable interval, but connected by a slender ridge across the stem. The fourth pair (in the specimen examined) consisted of small but perfect, petiolate and stipulate leaves. The stipules are ovate or narrowing to subulate and membranous, intrapetiolar, free, but touching one another by their contiguous edges, and also touching or even underlapping the edge of the petiole. From the point of contact of two intrapetiolar stipules a ridge runs down each side of the stem to the middle of the petioles of the next pair beneath. This applies to all the perfect leaves. The ridges decussate with the leaves, so that, although there are four ranks of ridges on the stem, they are interrupted on the two sides alternating with the sides bearing the stipules.

The stipules afford comparatively little protection to the terminal bud, and the stem is unbranched. The leaves are involute in vernation from the base nearly to the apex, but a small portion is open, giving each a quill-like appearance. Each is separately folded, and all attain a considerable size before opening, so that they protect the younger members of the bud.

Judging from the form of the four scale-like pairs of leaves, the stipules are derived by separation from their edges. This would leave the petioles without sheaths and at the same time allow the lamina to become involute at the edges from the base upwards. The ridges may perhaps indicate that the leaves or their sheaths were, in some ancestral form, connate by their edges and decurrent upon the stem in the form of wings as we see in some of the Compositæ. The leaves of *Carduus* are strongly decurrent upon the stem, but they are alternate. Before rising out of the ground the flowering-stem is bent like that of a germinating seedling.

The first pair of leaves are sometimes reduced to small scales, so that they with their stipules form a whorl of six scales surrounding the stem, as in species of *Galium*, *Rubia*, and others of that tribe.

In *Mercurialis annua*, Linn., the stipules are subulate, acute, membranous, of a pale white, and inserted upon the stem at the very base of the petioles, and falling rather early. The leaves protect one another and are involute in the bud. The stipules also assist in protecting the terminal bud, but they seem of more importance in protecting axillary buds in their young stages.

In *Dalechampia Roezliana*, Muell. Arg., the stipules are large (9 mm. long, 4 mm. wide), ovate, acute, many-nerved, with a strong midrib, inserted on the stem with a broad base, red when young, and persisting on the stems in a brown and withered condition long after the persistent leaves themselves have fallen.

The terminal buds are completely enclosed by each pair of stipules in succession, the latter come in contact by their flat, but perfectly free edges. The stipules are fully developed or nearly so while still in the bud, and exceed as well as enclose the leaf to which they belong. When a pair is sufficiently old to commence expansion, the enclosed leaf is seen to be folded along the middle, involute at the edges, incurved at the slender tip, and of considerable size.

Axillary leaf-buds are not very frequent, but they would be well sheltered by the stipules even if their development were delayed till after the fall of the leaf.

Axillary buds consisting of successively developed inflorescences are frequent and are amply sheltered by the stipules. Below the flowers are two large, opposite, coloured bracts, which become green, and each has a pair of stipules which close the space between the bracts and even overlap one another.

URTICACEÆ.

In *Chlorophora tinctoria*, Gaudich., the leaves are small, lanceolate-elliptic, alternate, petiolate, stipulate; the petioles short, slender, subterete, narrowly grooved above, downy, not dilated at the base, articulate, persistent.

The stipules are short, intrapetiolar, connate, downy, ciliate, persistent, except the upper portion, which gradually becomes brown and falls away. The terminal bud consists of conduplicate leaves, downy on the underside, very narrow at this stage and pushing out of a mass of stipules which are practically convolute round the younger leaves.

The first axillary bud develops into a spine about 3·7 mm. long. Later on a second axillary bud develops in a somewhat lateral position and seems to arise as a lateral bud of the primary one. Both are protected in their early stage by the stipules.

The stipules are described as lateral and caducous in the 'Genera Plantarum,' but they appear to me to be intrapetiolar, connate and persistent at the base.

The whole plant appears well adapted for a dry climate. It is a native of Brazil, and resembles *Acalypha capillipes*, *Flacourtea sepiaria*, and *Argania Sideroxylon* in habit; the two latter belong to different Natural Orders.

Ficus infectoria, Roxb., has the leaves alternate, petiolate, stipulate, oblong-cordate, glabrous, incurvi-nerved, coriaceous, persistent; the petiole subterete, narrowly channelled above, very slightly dilated towards the base.

The stipules are linear, obtuse, membranous, inserted upon the axis and surrounding the greater part of it, colourless, membranous, caducous; each is convolute separately round the bud which it almost wholly covers, and is entirely free at both edges. The stipules of seven or more expanded leaves may be seen upon the plant at the same time.

The terminal bud (as indicated above) is covered by the stipules which form a double covering, that is, of two layers deep.

The axillary buds arise early, but are small, and nestle in the axil of the comparatively broad petiole. The stipules also help to protect them in their early stages, or even completely cover them.

F. elastica, Roxb., has large, elliptic-oblong, coriaceous leaves, obscurely penninerved, persistent; petioles long, subterete, very slightly flattened above, thickened towards the base.

The stipules are inserted all round the stem, connate along both edges, forming a structure like a sharply-pointed extinguisher; the line of union along the anterior edges is scarcely evident, but that of the posterior edges is very evident. When first exposed they are very short and small, but during summer they gradually lengthen till they are 18–22 cm. long or more; in winter they remain dormant till the rising temperature, either natural or artificial, causes the bud to develop, when they lengthen in proportion to the growth of the next younger and enclosed leaf. When the latter attains a considerable size, the stipules split along the posterior edges and in a day or two fall away. They are therefore caducous, but only one pair is visible at a time.

The terminal bud is completely covered by the stipules.

The axillary buds are rarely evident, and only show themselves as minute, scaly points at intervals along the old stems. They rarely develop unless the terminal bud has been injured or removed.

The chief points of difference between this species and *Ficus infectoria* are apparently due to the fact that the latter produces its leaves very hurriedly like those of the Horse-Chestnut, thus accounting for the numerous pairs of stipules being present at one time, and that *F. elastica* develops its leaves very deliberately or at long intervals. The much greater size of the unexpanded leaf requires a longer period for development; hence the need for longer protection, and the reason for the presence of only one pair at a time. This also would seem to be the reason why those of *F. elastica* are connate, so as to give more effectual protection during winter or the resting period as well as in summer.

Cecropia peltata, Linn., also has large intrapetiolar stipules, inserted upon the stem, a great part of which they surround, free along the posterior edges, but intrapetiolar and completely connate there in front of their own leaf; two strong dorsal ribs face the edges of the petiole. They ultimately fall away.

The terminal bud is completely enclosed by the stipules of the last expanded or still developing leaf. In the growing stage the stipules of the next older leaf still surround and protect the greater portion of the bud.

The axillary buds are protected in their early stages by the stipules, between which and the stem they are situated.

This type differs from *Ficus elastica* by the stipules being connate along the anterior edges only, and that permanently.

ARTOCARPEÆ.

See Potter, in Journ. Linn. Soc. vol. xxviii. (1891), p. 344, and Trécul, "Mémoire sur la famille des Artocarpées," in Ann. Sci. Nat. sér. 3, vol. xiii. p. 38. On p. 44 the latter describes the stipules. He says:—"We find all stages between a simple stipule and two separate ones; they are axillary and free; their length varies from 1 or 2 mm. to 12 cm. (sp. of *Cecropia*) and breadth in proportion; they are inserted horizontally or obliquely."

MYRICACEÆ.

The 'Genera Plantarum' says with reference to this family:—"Stipulæ 0, nisi in *M. asplenifolia* spuriæ." The stipule-like organs in this species are subulate, acute, inserted on the side of the pedestal, tumid at the base externally, concave internally, and channelled to the top on that face. They fall, as a rule, before the leaves.

JUGLANDEÆ.

This order is exstipulate. In *Juglans* it is seen that the several buds which are produced in each leaf-axil are protected by the leaf-sheath and the hairy or scarious bud-scales.

Casimir DeCandolle (Ann. Sci. Nat. sér. 4, t. 18, p. 5) gives a short account of these buds; almost all the axillary buds abort, the branches being developed from the terminal buds.

CUPULIFERÆ.

In the Nut, *Corylus Avellana*, Linn., both the leaves and the stipules behave in a somewhat peculiar manner in the bud, as seen at the apex of the growing shoot in spring. The leaves are induplicate in bud or imperfectly conduplicate. The younger leaf as it is just leaving the bud lies somewhat above the latter, and is induplicate at the edges. The next younger leaf is conduplicate and closely applied to the bud, round which it is slightly twisted.

The stipules are oblong or oval, more or less deeply concave, and arranged in four ranks, two above and two below the spreading or horizontal branches, while those of each pair are unequal in size. The upper one, that is the one on the upper side of the branch, is the larger, and this lies over the leaf which has just left the bud. The smaller stipule lies under and protects the bud and a small portion of its own leaf. The stipules of the leaf still closely applied to the bud protect the latter, including their own leaf.

In the Alder (*Alnus glutinosa*, Gaertn., var. *laciniata*, Ait.) the stipules are oblong, obtuse, entire, 7–9 mm. long, deciduous, or falling away much sooner than the leaves, and therefore almost caducous, membranous, but subfoliaceous. They are of service in protecting the young leaves of the elongating shoots in summer, and also the axillary buds later on when they begin to develop.

They are evidently more serviceable in protecting the winter-bud, of which they constitute the enveloping and protecting scales, as in the case of the Oak, Beech, &c. There are two or three pairs of them without leaves, succeeded by two or three which do not attain perfect development. About two pairs without leaves are produced, and each pair is wrapped round the bud, almost completely covering it. Where leaves are also produced, the stipules lie inside the leaf to which they belong.

All are glued or gummed together by means of the resinous or gummy matter exuded by the glands copiously produced all over the surface of stem, leaves, and stipules.

In *Ostrya carpinifolia*, Torr. et Gray, the buds are ovoid, becoming oval or oblong as they elongate in spring, and laterally subcompressed. They are made up of, or are protected by, about seven pairs of stipules arranged in four ranks. The leaves when expanded are alternate and distichous, so that the stipules, protecting the bud and having no leaves of their own, are so arranged that the two from one leaf do not strictly overlap the two from the next younger leaf. In this way they are placed in four instead of two ranks. The Oak has only five ranks of stipules, although the leaves are arranged on the $\frac{2}{5}$ plan, the reason being that each rank is made up of stipules from two ranks of leaves. The divergence of the stipules from one rank of leaves in *Ostrya* is not great, however, so that of the four rows there are two contiguous pairs of rows, one on each side of the stem. All the stipules are firmly held together by a gummy material. After the seventh pair of stipules comes a perfect leaf folded over the bud, which thus prevents it from being conduplicate. The leaves, moreover, are slightly plicate in an ascending direction, following the course of the lateral nerves.

SALICINEÆ.

Populus balsamifera, Linn., var. *viminalis*.—The winter-bud of *Populus* is protected by the stipules, which secrete and exude a considerable quantity of gum during autumn, and cover the younger ones, especially at the edges, binding the whole bud firmly together, throwing off the wet, and no doubt in itself acting as a protection to the strongly involute and tender leaves, which even at this period are of considerable size.

The outer and oldest pair are connate in one piece, which is firm and rigid in the centre, with broad, more or less membranous margins extending round the greater part of the bud, but less than half its length. The second pair are also connate, rather more membranous, extending round the bud till their edges almost meet at the base, and nearly as long as the bud. The third pair are connate, convolute, extending a little beyond the bud, which they completely cover at the top. They are stiffly membranous, but green, and completely covered with gum on both surfaces. The second and third pairs completely cover the bud, and, when removed, expose the first two leaves. They themselves have no leaves.

The first and second leaves lie in a furrow or groove where their stipules meet. The fourth pair of stipules are free, subulate-linear, with a strong and conspicuous midrib, lying in front of their own leaf, and overlapping by their edges as well as overlapping the posterior edges of the fifth or next younger pair. The fifth pair are precisely similar to the fourth, but smaller, and the fourth and fifth pairs completely cover the bud. Both pairs are considerably longer than their own leaves. The sixth pair are very much smaller, and only about two-thirds the length of their leaf. The seventh pair are even smaller, and only about one-third the length of their leaf. Both leaves have attained a proportionate size with their stipules such as they maintain when expanded in summer.

In *Populus nigra*, Linn., var. *dilatata*, Ait. (syn. *P. fastigiata*, Desf.), the leaves are alternate, petiolate, stipulate, deltoid, crenate, strongly involute in bud, and gummy, glabrous, deciduous; the petiole laterally compressed, but in the bud-state nearly terete, or altogether undeveloped in very early stages, and gummy.

The stipules are more or less boat-shaped or keeled or concave, gummy, folded over the bud, and having their edges in front of their own petiole, so that they protect younger members. The outer or exposed ones of the winter-bud are reddish brown, and elongate to some extent with the developing bud in spring. The inner ones attain a much greater length, and are narrower and green; all are caducous.

The terminal bud is, in winter, covered by several pairs of stipules, some of which belonged to leaves which fell in autnmn. Some of the reddish-brown stipules, however, have well-developed leaves. About two or three pairs cover the winter-bud, while one or two pairs cover the growing one. The axis is therefore continuous, and all the leaves apparently are perfect.

Axillary buds remain comparatively small till spring, and are protected by scales which are modified stipules, as in the terminal bud.

While in *Populus* the buds are protected by the stipules, in *Salix* the stipules are small, and this function is performed mainly by the leaves. Thus in *S. cuprea* the winter-bud is covered by a pair of leaves reduced to brown scales which are connate, forming a cap splitting along one side in spring and partly along the other. Each of these modified leaves has a strong midrib or shallow keel. Succeeding leaves are very silky or tomentose beneath, and perfect; or one to three of them may, under certain conditions, remain small, dry up, and fall early.

The stipules are very small, tooth-like, ovate, silky, ciliate, and the lower ones fall early, or withering, remain for some time on the stem. They seem to be functionless, as far as the protection of either terminal, axillary, or winter buds are concerned.

The axillary buds, which alone are designed to produce the branches next year, are completely hidden and protected by the deeply concave base of the petiole.

The stipules, however, though always very small in bud, and in some species (*S. retusa, Grahami, cuprea, repens*, &c.) permanently so, in others become larger, and in some (*S. dasyclada, myricoides*, &c.) attain a considerable size. Their chief function appears to be to protect the axillary buds, which are also sheltered by the dilated and concave bases of the petioles.

Masters, in his 'Vegetable Teratology,' mentions (p. 357) an increase in the number of stipules in *Salix pendula*; a monstrosity which gave rise to the variety *multistipulata*, Seringe.

CASUARINEÆ.

The small scale-like leaves in *Casuarina* can serve but little purpose except as a bud protection; the furrow between the ridge of the stem which is opposite the leaf would also assist.

MONOCOTYLEDONS.

It may be a question whether any Monocotyledons have true stipules. The younger leaves are generally protected by those more advanced.

SCITAMINEÆ.

In *Hedychium flavescens*, Lodd., the leaves are alternate, very shortly petiolate or subsessile, sheathing, stipulate, oblong-lanceolate, acuminate, narrowed to the base into a very short channelled or subwinged petiole, and having a distinct midrib from whence arise numerous, very slender, sharply-ascending, parallel nerves.

The sheaths are very long, connate in the lower portion into a complete cylinder, and open towards the top as in the Gramineæ. Numerous sheaths enclose one another and surround the central floral axis. The stipules form a membranous brown margin adnate to the edges of the sheaths, but at the top of the sheath they become free from it, and are connate in one piece in front of the short petiole, and therefore intrapetiolar. In this they strongly resemble the ligules or the stipules of the Gramineæ; but they are much longer, measuring 2·5–3 cm. or more.

The terminal buds consist of leaves completely convolute from one edge to the other into a cylinder like a roll of parchment surrounded by the sheaths, and finally by the stipules before making their exit. The lamina cannot unfold until by the elongation of the axis it has been pushed out beyond the stipules.

As the stems do not branch, there are no axillary buds except from the fleshy persistent rootstock. The lower leaves from these basal buds are wholly reduced to their sheaths, which terminate in a mucro corresponding to the midrib. The stipular portion consists of a narrow rim wholly adnate to the sheath except a small rounded tooth on each side of the terminal mucro. The first leaf having a small lamina, has also connate but short stipules. These sheaths are connate for a short distance at the base only. In all these cases the young leaves, axis and inflorescence, are well protected by the sheaths and stipules. The latter serve to cover the terminal opening of the sheath the more effectually, and thus prevent rain from getting inside the sheaths.

LILIACEÆ.

In *Smilax* the leaf-stalk is more or less winged at the base to protect the young bud from drying or other injury. In some species, e. g. *S. ovalifolia*, Rottb., and others, these sheaths attain an extraordinary size, and are turned up at the edges, forming pockets in which, as Burck in his paper already referred to points out, ants come to live. Burck thinks the large development of the sheath is not due to the necessity of bud-protection, but results from the benefit accruing to the plant from the presence of the ants.

PALMEÆ.

In *Korthalsia* the base of the petiole is developed into a large swollen ocrea: ants use the chamber thus formed as a home.

NAIADACEÆ.

In *Potamogeton lucens*, Linn., the stipules are very long, intrapetiolar, and completely folded round the axis to which the base is adnate, and slightly overlapping along their posterior edges where they are entirely free, while they are entirely connate by their anterior edges in front of the petiole, membranous but tough, and 4·3–5·5 cm. long, the basal and the terminal ones being the shortest, but still highly developed. The only evidence of there being two connate stipules is supplied by the two stronger nerves, one on each side of the middle line and in the position of the middle line in front of the petiole. Each stipular piece protects all the younger leaves in succession, but not their own leaf. The terminal bud is thus well protected by the long stipules, which attain a length of 4–4·3 cm. before the oldest enclosed leaf is liberated. The unrolling of the two sides of the lamina takes place from the apex downwards as the leaf gets liberated.

Axillary buds are protected by the full-grown stipules before the latter become disarticulated from the stem. The first two leaves of axillary buds are sometimes, if not always, reduced to their stipules, which are short, but connate in one piece like those of the main stem.

Potamogeton densus, Linn., is the only British species which is exstipulate. The leaves are more than semi-amplexicaul, and convolute round the axis, one within the other alternately on the two sides of the stem upon which they are inserted. Owing to this arrangement, they appear alternate as they emerge from the bud. The outer leaf is developed slightly in advance of the inner; that is, it is slightly the longer, although both are inserted upon the same level.

The internodes of the stem are always relatively short, but near the apex they are so short that the leaves are crowded and appear emerging from one another; so that not only is the terminal bud thus amply protected, but the axis as well for some distance behind the apex.

Axillary buds are protected by one leaf, placed opposite the leaf of the main axis, greatly reduced in size, and more than half amplexicaul, so that the lamina is wrapped round the bud. This is followed by perfect and opposite leaves. This is the only British species that is exstipulate.

The large leaf-sheath in the genus *Naias* affords good protection to the bud; its varied form also supplies specific characters.

GNETACEÆ.

In *Gnetum Gnemon*, Linn., the leaves are opposite, petiolate, exstipulate, elliptic-oblong, leathery, glabrous, persistent; the petioles semiterete, flattened above, articulate above the dilated portion, which is persistent, connate around the axis, and prolonged into a short rounded tongue in front of the petiole.

The terminal bud in the resting stage is completely enclosed by the short sheathing ring and prolonged tongue, which resembles that seen in *Clusia* except that it belongs more to the stem than to the petiole.

Axillary buds are also covered by the sheath above mentioned, but seldom develop into branches.

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